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Vol. LXVII No. 5 May 1926

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The Geographical Journal

Vol. LXVII No. 5 May 1926

CENTRAL SINAI

H. J. L. Beadnell, M.I.M.M., F.G.S., late of the Geological Survey of Egypt

Read at the Meeting of the Society, 25 January 1926.

EARLY in November 1921, on my return from an expedition to the west of the Great Pyramids, I received instructions from the Egyptian Government to examine and map the unexplored central portion of the Peninsula of Sinai. My northern limit was to be taken as the parallel of lat. 29° 30′ N., the topography north of which had been completed before the war by the British Military Authorities and the Survey of Egypt, while the geology, in the hands of my colleagues Mr. F. W. Moon and Dr. H. Sadek, was at the time nearing completion. On the south I was, so far as time permitted, to join up to the areas mapped by three earlier expeditions in Southern Sinai, in charge of Dr. W. F. Hume (the present Director of the Geological Survey), the late Mr. Barron, and Dr. John Ball, now Director of Desert Surveys.

The area geologically examined, and mapped topographically on the scale of 1/100,000, amounted to 6000 square kilometres. A memoir embodying the results of this and of a subsequent expedition will be published by the Egyptian Government.

The opportunity of exploring this large tract of between 3000 and 4000 square miles, much of it *terra incognita* to geographical and geological science, came to me as an unexpected and therefore doubly welcome Gift of the Gods. My previous expeditions had always been in the comparatively monotonous Libyan wastes, or in the Eastern Desert and Red Sea Hills, and I had long yearned for a winter's work in the more favoured wilderness of Sinai, where the questions of water and fuel supplies do not have to be so constantly kept in the forefront of one's mind. Last and not least was the great chance of examining a region which lay athwart, if not within, the greatest belt of rifts or tension-subsidences on the Earth's surface, and the probability of obtaining important evidence on a subject about which so much had been written in recent years, more especially by Professor J. W. Gregory, of Glasgow University.

The coastal plain between Suez and Tor, along which lies the usual route to Gebel Musa and the Convent of St. Katherine, was fairly well

known, and some portions of it had been mapped in detail by members of the Geological Survey. A few travellers had extended their journeys to the Holy Land by one or other of the desert roads from the convent to Aqaba, along the eastern margin of the peninsula; of these must be mentioned Léon de Laborde, who traversed this region nearly one hundred years ago, and Professor Edward Hull, at the time Director of the Geological Survey of Ireland, who went out for the Palestine Exploration Fund in 1883, and who was joined in Egypt by the late Earl Kitchener, then a Major in the Royal Engineers.

I should mention also another Briton of imperishable memory who travelled in Sinai—Doughty, the intrepid explorer and distinguished author of 'Arabia Deserta,' who died last week.

Reliable information regarding the interior of the region I was about to explore was practically confined to a north and south route-traverse of Gebel Egma, which had been made the previous winter by Mr. Meldrum, of the Desert Surveys. Mr. Meldrum informed me that his men had absolutely declined to enter the territory to the east of the great central tableland, an area which was constantly raided by the turbulent Maaza Arabs from the other side of the gulf, and which, since the withdrawal of effective Egyptian Government administration during the Great War, had become a kind of No Man's Land, destitute of law, order, and security.

With our departure on November 20 from El Shatt, a small quarantine station on the banks of the canal opposite Suez and Port Tewfik, we were quit of civilization for four or five months. The caravan consisted of Sheikh Hussein Sayid, a postman, a guide, four Saidi boys from Upper Egypt to act as instrument porters, two Frontiers District Police, riding-camels for myself and personal servant, and sixteen baggage camels and their attendants, the latter belonging to the Aleigat, Sawalha, and Um Zeina sections of the Tawara Arabs, who claim most of the territory we were about to explore.

A short day's march took us to Wadi Rieina, a shallow watercourse south of Aiyun Musa, the "Springs of Moses"—a little oasis of palms watered by trickling streams. The springs are mostly at points considerably above the general plain-level, the high ground having been formed by the gradual accumulation of decayed vegetation, combined with sand and dust blown from the surrounding plains and held up by the damp bush-covered ground around the springs. In remote times Aiyun Musa was a place of importance, being the chief source of water for Red Sea shipping. Up to fifty years ago it remained a residential site for the merchants of Suez, and was only finally abandoned on the completion of the Suez Canal, when the town obtained an adequate water supply by the restoration of the old sweet-water Ismailia canal from the Nile.

Crossing Wadi Sudr the following afternoon recalled the tragedy

enacted here in August 1882, when Professor Palmer, foremost Arabic scholar of his day, with his companions, Captain Gill, R.E., and Lieut. Charrington, R.N., were murdered in cold blood by Deboura and Tarabin Arabs. The party were purchasing camels for the English expedition against Arabi Pasha, and the murder was probably instigated by Arabi's agents in Cairo. The actual plot was treacherously arranged by a trusted member of Palmer's escort, one Meta Abu Sofia, belonging to the Deboura section of the Hueitat Arabs, the primary object being doubtless the large sum of money carried by the party.

The coastal plain over which we were now travelling is claimed by Professor Flinders Petrie and other archæological savants as the route followed by the Israelites after their miraculous passage of the Red Sea, but this view has recently been adversely criticized by Mr. T. Eric Peet, who maintains that the Exodus proceeded from Pelusium and followed the shores of the Mediterranean eastwards. The plain has an average width of about 15 miles, is composed of Miocene or younger sediments, and is bounded on the inland side by the prominent escarpment of Gebel Raha, here and there broken by lines of drainage from the higher plateaux inland. Access to the interior is provided by these wadis, and south of our northern limit, lat. 29° 30′, there were two such from which to choose—Wadi Wardan and Wadi Gharandel, the exits of which are approximately 45 and 50 miles down the coast from El Shatt. According to Said Hamdan, a most agreeable but somewhat inefficient guide, the latter afforded the quicker and easier access to the interior plateau Gebel el Tih, an opinion which seemed to be borne out by a very sketchy chart of the coastal plain and its bordering eastern ramparts, which was in my possession.

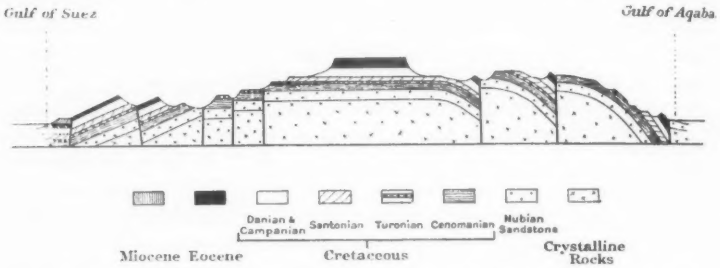
Here then, at the point where Wadi Gharandel debouched from the high ground, a camp was made for the next few days while I measured a base from which to commence our mapping, and whence I made excursions to obtain an idea of the general topographical and geological structure of the western margin of the peninsula.

General Structure.

Briefly, the structure in this district was found to be as follows: On the west, a low-lying coastal plain of approximately horizontal Miocene strata; an interior plateau capped by hard Turonian limestone, with scarps of Cenomanian sediments, dipping very gently northwards; and in the centre a belt of highly tilted rocks, exhibiting a succession from the Lower Eocene through all the stages of the Cretaceous down to the pre-Cenomanian basal Nubian Sandstone. These great blocks of inclined rocks, often repeated in separate parallel ranges of hills, are bounded by faults of considerable throw, mainly parallel to the Gulf of Suez. During the course of the expedition I was able to trace these master dislocations in both directions and to connect them up with those

previously shown to exist to the north and south of my district by M. Barthoux, by my survey colleagues Dr. H. Sadek and Dr. Ball, and by the late Messrs. Barron and Moon.

Considered in conjunction with the dislocations known on the western side of the Gulf of Suez, it seems safe to conclude that the whole of the great low-lying basin occupied by the gulf and its coastal plains, is either a foundered tract or an area which has failed to participate in the general elevation—an upward movement of the crust that resulted in the formation of those immense tablelands which are such a feature of Egypt,



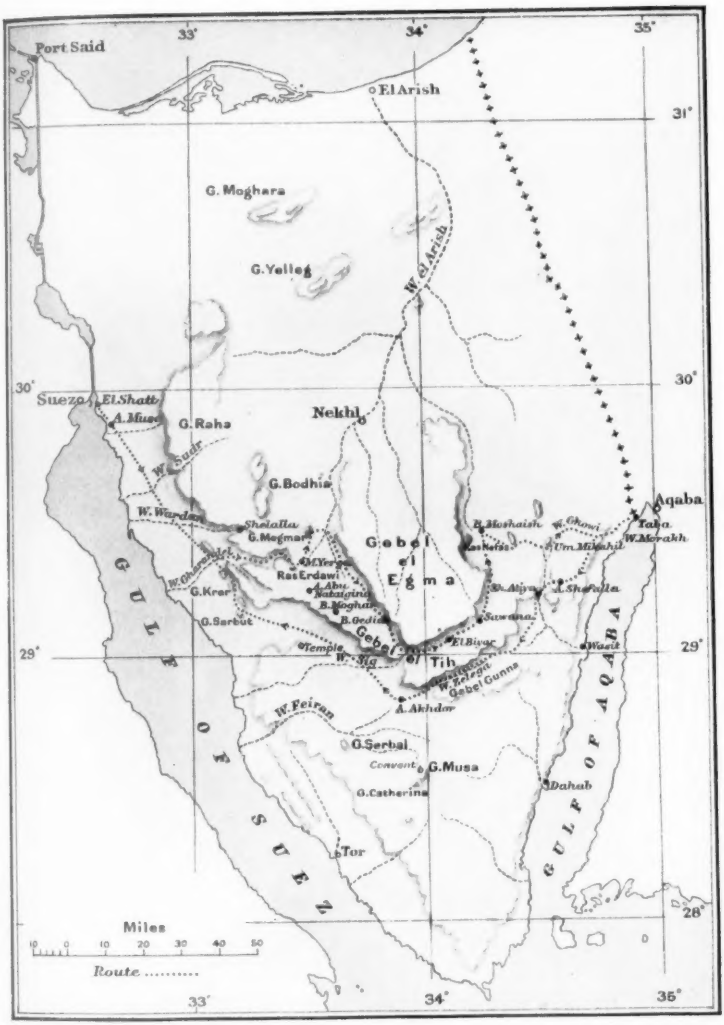
Diagrammatic cross-section through Central Sinai to illustrate the structure and stratigraphy, and to show the relative positions of the main faults.

occupying the centre of the Peninsula of Sinai and forming the deserts on either side of the Nile Valley.

Contrary to expectations, Wadi Gharandel proved no short and easy route to the Tih plateau. A full fortnight was occupied in mapping it and its tributary gullies before we emerged at Ras Erdawi, the black hill, or neck of volcanic rock, on the tableland at the head of the wadi, 28 miles from our base-line camp. The valley, narrow and tortuous in its upper reaches, is bounded by steep walls of rock, and these had to be climbed several times daily in order to maintain a satisfactory plane-table traverse. In the central portion this great drainage channel is known as Wadi Abu Qada, and, still higher up, as Wadi Hegya. Several good water-sources exist, the more important being Bir Barazi, Ain Abu Giyaib, and Ain Hegya.

Tableland of El Tih.

At Ras Erdawi the immense tableland Gebel el Tih, or "Mountain of the Wanderings," lay spread out around us, and from here we obtained our first view of the still higher plateau known as Gebel el Egma, with its precipitous snow-white escarpment of chalk. A few hours' ride to the south lay the southern extremity of the Tih plateau, whence, from the crest of the immense cliffs facing south, one overlooked the golden-coloured plains of Debet el Qeri and the apparently interminable maze of black jagged peaks of crystalline rock beyond. Among these nestles



SKETCH-MAP OF CENTRAL SINAI, SHOWING MR. BEADNELL'S ROUTE IN 1921-22

PERENNIAL SPRINGS IN WADI WARDAN, AIN SHELALA

GEBEL HAYALA, GEBEL KRER RANGE, FROM AIN DARAIRA

the Convent of Saint Katherine, at the foot of Gebel Musa, the reputed Mount of the Law, where, as the Arabs say, God spoke with Moses.

The greater part of Central Sinai is drained by the Wadi Arish system, which reaches the Mediterranean at a point about 100 miles east of Port Said. Wadis Wardan, Gharandel, and Wata—the latter a very large tributary of Gharandel from the south side—although forming deep incisions in the Tih tableland, capture little of its surface run-off. The occasional but heavy rains which fall on the southern uplands of the Tih are largely absorbed by the northward-dipping Turonian limestones, filtering through the latter along joint and bedding planes to reappear as springs at favourable points on the lower ground to the north. One of these springs is the picturesque Moyat Yerga, a deep pool at the head of a narrow gorge a couple of miles north-east of Ras Erdawi. Large numbers of sandgrouse and partridges frequent this spot, where good clear water, uncontaminated by sheep, goats, and camels—which can only obtain access to the tail-end of the pool—is always available in quantities sufficient to meet all possible requirements.

From Moyat Yerga we proceeded due north to examine the conspicuous isolated hill known as Gebel Megmar, one of those extraordinary upward bulges of strata of which many examples are described by Messrs. Moon and Sadek in the 'Survey Memoir on Northern Sinai.' These extremely localized domes or anticlines, the formation of which one is at first sight tempted to ascribe to intense lateral compression, are of the greatest interest in a region where the dominant structures appear to be the result of tension-stresses. Possibly they have been caused by the expansive action of intruded magmas—masses of basalt, in the shape of dykes and sills, being common features in many parts of the peninsula.

Gebel Megmar district is inhabited by a local tribe of Arabs, the members of which eke out a precarious existence by charcoal burning and by cultivating small areas of silt in the Wadi Arish. Although kindly disposed and unobtrusive folk, these Arabs are more than usually superstitious. Firmly convinced that my survey cairns would keep away the occasional rains on which their livelihood so much depends, they had them all levelled to the ground almost before we were clear of their district.

From Gebel Megmar our course lay along the foot of the great wall of the Egma tableland. This magnificent escarpment of white chalk and chalky limestone increases in height as it is followed southwards, until, at its extremity Gebel Geneina, the cliffs are over 1200 feet from top to base, the summit being 5348 feet above sea-level and one of the highest points in Sinai, only in fact exceeded by a few of the igneous peaks in the south of the peninsula. In the centre of these chalky limestones—perfectly conformable throughout—is a darker band of more shaly nature, which detailed geological work eventually verified as marking the passage from Cretaceous to Eocene.

On arrival at Bir el Gedid we were about midway between the gulfs

GEBEL HAVALA. GEBEL KRER RANGE. FROM AIN DARAIRA

SPRINGS IN WADI WARDAN. AIN SHELALA

of Suez and Aqaba, and here, through some casual remarks which passed between the Sheikh and my guide, I got my first warning that the men were getting panicky. The occasion was Christmas Day, when Said Hamdan and I returned to camp some time after dark, following a long day on the plateau above. Their fears of trouble with the Tiaha Arabs of Gebel Egma did not however at the time concern me, as I had already decided to postpone tackling the eastern half of the peninsula until after the return of a detachment of camels which I was sending back to Suez for further supplies of flour and grain. To celebrate the date, Mohammed Abu Kafo—my faithful servant for nearly twenty years—exerted his utmost culinary skill, my dinner that evening terminating in a plum-pudding served enveloped in flames in the good old fashion. Unfortunately, wishing to spring a complete surprise and not having access to any brandy, he had saturated the pudding with methylated spirit!

On our return journey from Bir el Gedid we mapped the southern portion of the Tih plateau and descended to the coastal plain by the more northerly of the two great lines of drainage already mentioned, known in its lower reaches as Wadi Wardan.

The middle part of this valley—Wadi Shelala and Wadi Sig—is cut out in the Cenomanian series, which is mostly composed of soft sandy and clayey beds, but includes bands of intensely hard limestone, one of which is seen in the illustration of my camping-ground at Shelala, where a small stream forms a delightful cascade with deep pools of limpid water below. From this point the wadi is difficult to negotiate with laden camels; vertical walls of rock bar the bed at intervals, while the slopes are littered with fallen boulders from the harder bands outcropping above. Everywhere the series has been invaded by massive dykes and sheets of basaltic rock, the former occupying faults or fissures which were in many cases determining factors in the position and direction of both main and tributary valleys.

East Side of the Peninsula.

We returned to the east by a very zigzag route, which enabled me to fix the positions of several important springs, such as Ain Abu Nataigina and Bir el Moghara, and to complete my map of the Tih plateau. After being held up a day by rain, which made the chalky ground at the base of the escarpment so slippery as to become impassable by camels, we rounded the southern extremity of the Egma tableland on January 25, and camped at the water-holes of El Biyar. Another day's march took us to Moyat el Sawana, the track hugging the base of the cliffs and thus avoiding the extremely broken country which lay to the east, a plateau geologically the counterpart of that to the west of Gebel Egma and deeply intersected by the upper tributaries of the Wadi el Ain, which drains into the Gulf of Aqaba.

Opinion differs as regards the extent of country to which the name

Gebel el Tih should be applied. Those Arabs with whom I became personally acquainted in Sinai seem to confine the term to the lower plateau west of the more elevated central tableland, which latter was always referred to as Gebel el Egma.

Moyat el Sawana is a natural rock cistern or "galt," and entirely dependent for its supplies on flood water descending the Wadi Sawana after rains on the plateau above. A long tortuous track connects the galt with the latter, and in normal times this pass is alive with flocks of camels, sheep, and goats, driven to be watered here from all parts of the tableland, which, though affording some of the best grazing in the peninsula, has practically no water supplies of its own. At the time of my visit all this eastern portion of Sinai was almost deserted, only a few of the bolder spirits remaining, after sending their womenfolk and animals to less disturbed parts, to retain their local claims against a return of quieter times.

My men were now more or less openly exhibiting their reluctance to proceed further, but trouble was temporarily avoided by the engagement as armed guide of a Tarabin Arab, one Rashid Suweilim, a loud-voiced, cantankerous, but on the whole good-natured fellow, full of self-assurance and armed with a modern magazine rifle and a bandolier well filled with cartridges. During the Turkish retreat before Allenby large quantities of rifles and other equipment fell into the hands of the Arabs, and the former are now traded amongst them at the price of two to three pounds apiece. Many men I met were armed to the teeth and wore British, German, or Turkish infantry great-coats.

Proceeding northwards, mapping the eastern limits of Gebel Egma *en route*, we arrived four days later at Bir el Moshaish, from which point I was able to connect with the military maps of the territory north of lat. 29° 30′ N. To the west and south-west of Bir el Moshaish the Egma tableland breaks up, isolated outliers of the plateau rising here and there from a denuded desert of soft snow-white chalk. A magnificent view unfolds itself from the summit of Ras el Nefas—one of these precipitous-sided detached plateau blocks—embracing Gebel Bodhia, 60 miles to the west-north-west, and the crystalline ranges on the east side of the Gulf of Aqaba. Northwards one can see to the point where the Egma tableland as a topographical unit ceases to exist, its hard uppermost beds having finally dipped below the general level of the plain.

From Bir el Moshaish I intended to proceed due east to the old Egyptian–Turkish boundary at the head of the Gulf of Aqaba, a programme I was able after some trouble and much opposition to carry out. At the outset however the camelmen flatly refused to go further east, while Said Hamdan and the Sheikh kept silence, hoping I would give in but afraid to openly line themselves with the men. Fortunately at this juncture there turned up in camp a Tiaha Arab of the name of Salama, one of the most turbulent individuals in this part of the country, a splendid

guide, and a man who apparently feared neither God nor man. Salama was nothing loth to being enrolled as an extra armed guide on good wages, and he assisted me later on in procuring two other similar rascals on the same terms, so that when confronted with the fact that I intended to annex half a dozen camels and proceed with my new recruits, my boys from Upper Egypt—who were good sportsmen—and the two F.D.A. men, the camelmen gave up the idea of deserting, influenced no doubt by the fact that they would have some difficulty in explaining their conduct on arrival at Suez, where they would have to go if they were to claim their arrears of pay.

Eight miles east of Bir el Moshaish we struck the upper reaches of the Wadi Buttum, so called after an immense tree of that name, in the shade of which we lingered for a brief spell. Following the valley we descended with the dip of the beds until we reached Gebel Um Mikahil, where the Wadi Buttum turns at a right angle to the south, to form the upper portion of the Wadi Watir, a comparatively low belt of country marking the site of, and determined by, one of the great crustal dislocations which traverse this region. This particular fault, which was first noted by Hull when traversing this area with Kitchener in 1883, I was able to trace and map for over 30 miles. In places it has a throw to the west of over 1800 feet, bringing the Lower Eocene limestone against the Nubian Sandstone.

At our next camp, in Wadi Haisi—another large feeder of Wadi Watir —we had an alarm which, though it proved false, was an indication of what would probably happen were we unfortunate enough to attract the attention of a genuine raiding party. One evening, just as I reached camp, a party of mounted Arabs was seen coming in our direction from the higher ground to the north. A tremendous commotion ensued, the men yelling "El Gom, El Gom," while the Sheikh rushed up and implored me to get my rifle ready, as the Maaza were upon us. When the enemy turned out to be "friendlies" from Northern Sinai there was considerable chaff and amusement, as at the first alarm many of the men had bolted into the surrounding hills. Some of these afterwards tried to save their faces by asserting that they had gone to look for better positions from which to repulse the raiders.

Salama having arranged with two of these new-comers to join us, I now felt we could, with reasonable precautions, hold our own with any marauding party we were likely to encounter, as seven of us were armed with repeating rifles and I had four men intimately acquainted with the country ahead.

Six miles to the east of Wadi Watir other master faults were found traversing the country from north to south, the downthrow, measuring up to 2250 feet, being always to the west, while the dip of the beds, throughout the blocks separated by these great fractures, remains fairly constant in the direction of the Gulf of Aqaba.

GEBEL KRER, FAULTED BLOCK ON WEST SIDE OF PENINSULA

ALLUVIAL DEPOSITS IN WADI THAL, NEAR GEBEL KRER

WADI WATIR BELOW AIN FURTAQA

WATER SOURCE IN A GORGE OF TURONIAN LIMESTONE. MOYA'T YERGA. TIH PLATEAU

Our forty-sixth camp was at the head of the Wadi Ghowi, on the summit of the bluffs overlooking the gulf, the panorama across the placid deep blue water to the towering mountains beyond being of unsurpassable beauty. The uppermost beds of these precipitous cliffs are fossiliferous limestones and clays belonging to the Cenomanian; below is a sheer face of brilliantly variegated sandstones resting on a lower plateau, a peneplain of dark-weathering igneous rock terminating in a second escarpment, washed at its base by the waters of the gulf. The deep shadows of the chasm-like gorges which dissect these bold escarpments, the almost entire lack of visible animal and vegetable life, the all-pervading silence, accentuate a scene of great though beautiful desolation.

On the Gulf of Aqaba.

As we were now so near Maaza territory there was no rush of volunteers to accompany me to our objective, the cairn at Bir Taba, marking the southern end of the pre-war Egyptian–Turkish frontier, near the head of the gulf. Taking only bare necessities for three days, my small mounted party descended to the seashore along a track following a small fault, which locally displaces the vertical wall of limestone capping the summit of the cliffs. The descent to the sea occupied over four hours, the path being extremely rough and with difficulty negotiated, even though our camels were very lightly laden and led by hand. A couple of hours' march along the coast brought us to the Wadi Morakh, where we bivouacked in the most secluded spot we could find. The returning tracks of a party which had recently raided this side were plainly visible on the shore, and I was glad to know that these Arabs had probably by this time rounded the head of the gulf.

Early next morning we passed "Pharaoh's Island"—Gezira Faraun—and completed our survey to Taba, where I was able to connect up my maps to the penultimate boundary beacon, the position of which was determined years ago by a boundary commission. From Taba the palms and houses of Aqaba, 8 miles distant, are plainly visible. Burckhardt considered that Aqaba can be identified with Aqabet Aila of the Arabian geographers, and with Akrabbim of the Bible (Numbers xxxiv. 4). Undoubtedly it takes its name from the steep pass by which the plateau to the west is gained. According to the same authority the fortress of Aqaba was built in the sixteenth century by Sultan El Ghuri of Egypt.

Immediately to the west of Bir Taba lies a large block of tilted sedimentary rocks, exhibiting every division of the stratigraphical sequence of Central Sinai, from the basal Nubian Sandstone to the Egma plateau limestone of the Lower Eocene. This faulted mass of rock at sea-level, several thousand feet below its normal stratigraphical position, forms an important link in the chain of evidence which indicates that the Gulf of Aqaba, like that of Suez, is a tectonic depression, within which the

Earth's crust has foundered or failed to rise with the adjoining elevated regions.

After our return to Wadi Ghowi we worked southwards along the summit of the escarpments, location being made by resection of Mr. Meldrum's triangulation cairns on the Egma plateau, which could always be picked up despite their great distance. Along the greater part of the coast the structure remains similar to that at our Ghowi camp, but about 20 miles from Taba the Cenomanian beds, instead of ending off abruptly at the top of the bluffs, were found to be bent over, forming a dip-slope which continued right down to the shore, where they are followed by the remaining members of the Cretaceous and the overlying Lower Eocene. The latter beds are here 5000 feet lower than on the Egma tableland, dip at a high angle to the east, and terminate abruptly against a fault, which at this point has a vertical throw of nearly 3000 feet. Contiguous to the Eocene on the foreshore to the east are horizontal beds of Nubian Sandstone. Cross faults bound this downfold on either side.

Returning to the Wadi Watir *viâ* Ain el Shefalla, we passed the tomb of Sheikh Atiya and made our way southwards along the great line of dislocation to the prominent conical hill known as Ras el Qelb, one of the best landmarks in the region. South of Sheikh Atiya the fault runs south-south-west, and most of the valleys in this district are rifts or trough faults with a similar orientation, a structure impressed on the mind by their walls of granitic rock and floors of sandstone.

Two miles south of Sheikh Atiya the Wadi Watir departs from the main line of faulting and follows a winding south-east course to reach the Gulf of Aqaba at the wells of Wasit near Noweibah. Lack of time prevented me mapping the valley beyond its junction with Wadi Haimur, but this has since been done by Mr. Clayton of the Desert Surveys, while completing the topography of all remaining blank areas on this side of the peninsula. In its lower reaches Wadi Watir is mainly a valley of erosion, though its chief feeders on either side are typical rift valleys with alignments only a few degrees from north and south, similar to those in Southern Sinai described by Hume in 1906. This narrow tortuous gorge, shut in by towering cliffs of granite from 1200 to 1500 feet high, is in striking contrast to the vast open tablelands of the interior.

Immediately south of Ras el Qelb palms mark the springs of Ain Um Ahmed, which give rise to a brackish meandering stream. At the time of my visit this stream extended a mile down the wadi, waterlogging the sandy floor and rendering it extremely treacherous. Such streams are by no means uncommon in Sinai, especially following a season of good rain. Camp should never be pitched in the Wadi el Ain, which in times of flood may speedily become a veritable death-trap. The wadi forms the sole exit to the sea for the drainage from a very large area of country on the north, south, and west, and following a cloudburst or heavy

rainstorm its narrow bed is sometimes filled to a great depth with an irresistible raging torrent.

Return to Suez.

At Ain Um Ahmed I paid off my four Eheiwat and Tarabin Arabs and commenced the return journey to Suez, following the long easy Wadi Zelegah to its source and descending thence to Ain el Akhdar—the "Green Springs"—a picturesque spot, with clumps of well-grown and carefully tended palms, in a moderately deep valley of crystalline rocks, conspicuous among the latter being brick-red porphyries.

From Ain el Akhdar our route lay along the base of the escarpment of the Tih plateau, a sheer wall of rock, over 1000 feet in height, extending almost without a break across nearly 100 miles of country. These cliffs form one of the most important topographical features of the entire peninsula, and mark the dividing line between the open tablelands of sedimentary rocks on the north and the intricate maze of granitic mountains forming the southern portion of the country. The greater part of these bluffs is composed of the Nubian Sandstone, in which at one point some interesting deposits of ironstone were met with, while at another a noticeable feature was the presence of dykes and sills of basaltic rock, the latter in one instance exhibiting well-marked columnar structure.

Immediately to the south of the southern extremity of the Egma plateau the Tih escarpment is deeply indented by the Wadi Sig, a line of drainage which is now cutting its course through the thick deposits of gravel which were laid down during an earlier period of its history.

Proceeding westwards we crossed the upper reaches of the Wadi Baba and passed to the north of the little Egyptian temple Serabit el Khadim. It was here that the stone tablet, in connection with which there has recently been some controversy in the daily press, was discovered by Sir William Flinders Petrie in 1915. Only a few weeks ago Professor Hubert Grimme, of Muenster University, claimed that he had succeeded in deciphering the inscription on the tablet in question, an announcement which has given rise to renewed interest in the early history of Sinai. According to Grimme the tablet was set up during the lifetime of Moses, the inscription commemorating his rescue from the Nile by Pharaoh's daughter, Queen Hatshepsut, and his subsequent advancement to high honours.

In this locality still older sandstones enclose marine deposits of Carboniferous age, which have been mapped and described in detail by my colleague Dr. Ball. Economically the district is the most important in Sinai, as here are situated not only the ancient turquoise workings but the modern manganese mines of Um Bogma, which yielded, I believe, an important part of our supplies of the metal during the war.

Our route now lay across the sandy expanse known as Debbet el Qeri, whence we proceeded past Gebel Sarbut el Gemel and Gebel Krer to Wadi Gharandel, arriving at our seventieth camp, at El Shatt on the Suez Canal, on March 25.

Second Expedition.

I do not propose saying more than a few words concerning my second Sinai expedition, which commenced some eighteen months later and afforded me the opportunity of visiting first, the very interesting district of Gebel Moghara, near the Mediterranean coast; and, secondly, what I may perhaps call Biblical Sinai, that is to say, the region which includes the well-known convent of Saint Katherine and Gebel Musa—the traditional Mount Sinai of the Scriptures.

Gebel Moghara was of peculiar interest to me, as until this district was visited by the French geologist Barthoux in 1912, no Jurassic rocks were known in any part of Egyptian territory. In view of the immense thickness of strata there exposed and the comparative propinquity to Suez and El Arish, it is extraordinary that this range of hills should have preserved its secrets for nearly seventeen years after the Geological Survey was established. Subsequent to the initial work of Barthoux and his colleague Douvillé, the area was examined and surveyed by Hume, Fourtau, Moon, and Sadek of the Geological Survey, and described in detail in the *Geological Magazine* and in the official memoir on Northern Sinai.

After my flying visit to Moghara I spent several months filling in the remaining blank spaces in the maps of Central and Eastern Sinai, more especially the interior of the Egma plateau, Gebel Gunna, and the Wadi Zelegah district. My work on this occasion was greatly facilitated by the excellent topographical sheets of most of these areas which had been prepared since my first expedition by Messrs. Meldrum and Clayton, of the Desert Surveys Department.

Biblical Sinai.

It was a red-letter day to me when, on completion of the work just mentioned, we pitched our camp in Wadi Sheikh, at the foot of Gebel Musa, within a short walk of the renowned monastery. The majestic grandeur of the mountains proved even finer than I had anticipated from the distant views I had so often obtained from the bleak tablelands far to the north. Although many have described them I do not think that any one has excelled the original account by Capt. Palmer, published in the Ordnance Survey memoir nearly sixty years ago.

During the few days available I made acquaintance with many of the more interesting sites—the small Christian chapel on the summit of Gebel Katherina, the highest point (8681 feet) in either Egypt or Sinai; Gebel Musa, held in veneration by Christian and Moslem alike; the Convent of Saint Katherine, dating from Justinian days and contain-

GEZIRA FARAUN, GULF OF AQABA

A PASS TO THE EGMA PLATEAU

ESCARPMENT OF THE EGMA TABLELAND

FOOTHILLS OF GEBEL BODHIA

WADI SAWANA, IN EOCENE LIMESTONE OF GEBEL EGMA

ing many literary treasures; the plain of El Rahaba, whereon the multitudes stood when the Holy Law was promulgated from Ras Sufsafeh, a spur of Gebel Musa; Gebel Serbal, perhaps the most impressive mountain in Sinai; and Wadi Feiran, where the battle between the Israelites and the Amalekites was fought. On the latter part of my return journey to Suez I crossed the plain of Markha, identified as the Wilderness of Sin; camped on the site of Elim; tasted the bitter waters of Marah, and arrived at my destination worried only as regards the rival claims of Gebel Musa and Gebel Serbal to be the Mount of the Law. It was only after my return to civilization that I discovered that all these old identifications were suspect, and that according to the most recent authorities the Exodus proceeded, not into the southern part of the peninsula, but along the Mediterranean coast to Southern Palestine. Fortunately it is not for me to express an opinion on this thorny question.

Sport and Climatic Conditions.

Camp life in the peninsula compares very favourably with that in other parts of the Egyptian deserts, and my time in Sinai was one long spell of unalloyed pleasure. Grazing, fuel, and water are comparatively abundant, though many of the springs are far from satisfactory on account of the large content of dissolved salts or as the result of contamination by domestic animals. Sport is often easy to obtain, the small game including hares, lesser bustard, sandgrouse, and two species of partridge. One is thus often able to dispense with canned meats for fresh and less expensive fare. In the more mountainous parts gazelle are seldom seen, but ibex are common on the higher cliffs and peaks. Since the diffusion of modern rifles among the Arabs these wild goats have become exceedingly wary and difficult of approach. Leopards exist, but are rare, or at any rate seldom seen, and only on one occasion did I come across fresh spoor. In the chalky foothills of Gebel Egma I once met with the tracks of a small mammal quite new to me, and known only to a very few of the natives of whom I made inquiries. Even the promise of substantial bakshish failed to produce a specimen of this animal, called Abu Ka'ab—the father of heels—owing to the length of its feet. From the information I acquired, which included the fact that the beast has a highly objectionable odour, I conclude that it is some kind of polecat, possibly *Ictonyx frenata*, a species which ranges from Senaar to Asia Minor.

Climatic conditions during the winter months are at times very severe. Fierce penetrating winds blow unchecked across the plateaux, heavy rainstorms are by no means infrequent, and the temperature often drops below freezing, with occasional falls of snow. On the other hand, in the closed wadis and on the shores of the Gulf of Aqaba, the heat, even in winter, is often overpowering.

The Arabs.

Mr. Currelly, the co-author with Professor Flinders Petrie of the monumental work 'Researches in Sinai,' describes the Bedouin of the peninsula as 'mean, thieving, and lying.' This harsh judgment seems to me hasty and not altogether merited. Personally, I respect and have always got on well with the Arabs, though I must admit that in my dealings with them I have had whatever advantages may pertain to being a Government official. Their hardiness and abstemiousness have always appealed to me. No race of mankind eats, drinks, smokes, and wears less than these intelligent and dignified children of the desert. Certainly also they wash less and work less, but this is the result of their rigorous environment, and is easily understood when one considers how their very existence depends on what, in any other country, would be regarded as meagre and negligible supplies of water of extremely questionable quality, and that any surplus output of energy means additional requirements of food and drink. Quarrelsome they are, quick to take advantage of one's necessities, maddening in their importunities when one crosses a tribal boundary. But treated with firmness, reason, and understanding, they carry out their job to the best of their ability, and they have the inestimable quality of putting up with all the little difficulties and hardships, inseparable from desert exploration, without grumble or murmur. Frankly I like them, their perfect faith in Allah, their entire disregard of to-morrow, and their charming salutation "May your day be happy."

Before the paper the PRESIDENT (Dr. D. G. HOGARTH) said: We are to hear to-night about a part of the world whose name, at any rate, must be familiar to everybody—so familiar that it is surprising there should still be a paper to read to the Royal Geographical Society about it. It has been so trampled by armies in the north and so trampled by tourists in the south on their way to Gebel Musa and the Mount of the Law that one forgets there is a very considerable intermediate region of great interest from various points of view, both geological and scenic, which has hardly been visited, and, if visited at all, has been traversed quickly by small Egyptian parties concerned with the revictualling or reinforcing of posts along the old boundary between Egyptian and Turkish territory. I have said, very interesting geologically, and I leave the illustration of that to the reader of the paper to-night, who is a professed and expert geologist. Scenically, I do know something of Sinai. I have seen it from every side, and I do not think any view is likely to remain longer in my memory than that of Sinai seen from Aqaba, from the east side, against the setting sun, the most extraordinary and, in some ways, the most appalling view I think I ever saw: a blood-red bristling horizon of peaks seen against the red sun—the sort of landscape one might imagine in the moon—or in hell! Mr. Beadnell will illustrate its various features to-night. He has had a long experience in Egypt. I first knew of him many years ago as having explored the western oases of Egypt. Recently he has been used by the Egyptian Government to survey in Sinai. He has the exceptional qualification for survey work that he knows not only how to survey what is

on the surface of the Earth, but what is underneath; that is to say, he examines thoroughly the geological formation of the country. For that reason his surveys of Sinai are of particular value, and in recognition of that fact, when he sent into the Society a paper upon recent surveys of Sinai, we invited him to address the members. I will call upon him to read his paper.

Mr. Beadnell then read the paper printed above, and a discussion followed.

SESOSTRIS SIDAROUSS BEY (*Chargé d'Affaires*, Egyptian legation): I have had this evening the great privilege of being the guest of the Geographical Club and of the Royal Geographical Society. I feel it my duty to tender my deep appreciation for this honour and for the pleasure I enjoyed. I need not tell you how delighted and interested I was in listening to the most instructive lecture by Mr. Beadnell, the eminent explorer; and as an Egyptian I may say that I am very proud to offer him my heartiest congratulations and my sincerest thanks.

Sir ERNEST DOWSON (Surveyor-General of Egypt, 1909–19): As a previous colleague of Mr. Beadnell, I hope I may add to the congratulations which the Egyptian *Chargé d'Affaires* has so kindly given to the lecturer this evening. After the photographs you have seen, you will probably appreciate how valuable a work Mr. Beadnell has carried out, I mean as distinct from his very interesting paper. When one thinks that in the course of five months from Suez to Suez he mapped on a scale of, roughly, half an inch to a mile an area of between 3000 and 4000 miles—of course, not in detail, but, nevertheless, effectively for the purpose in hand—and when one remembers the broken nature of the ground and the various other difficulties that he mentioned one realizes how large a task it was.

Mr. Beadnell observed that the northern limit of his work was bounded by the survey that was carried out in conjunction by the Egyptian Government and the British Military Authorities for military purposes. Sinai, of course, throughout history has been a bridge between Asia and Egypt over which armies and peoples have incessantly passed. The military survey, to which reference is made, was the most recent piece of work prepared for the defence of that bridgehead. The President said that there should be no more papers left to read dealing with Sinai. The history of that ten years' survey—for it took about ten years to do—is one of the papers which the Society has not yet received and probably will not ever receive, because, like so many good stories, it will never be told. But if it could be told it is full of names that are well known to you.

It was a military reason that gave rise to the survey of Northern Sinai, though it has been a great advantage to Egypt for many other purposes. The survey, of which Mr. Beadnell's work was part, was due to economic reasons. You probably appreciate how large a part of Egyptian territory is desert. There is an extraordinarily fertile tract about the size of Belgium surrounded by big deserts, east and west, which total about the size of France and Germany combined. You realize how important it is to the Egyptian Government and people to endeavour to discover and make use of those territories. It was for that purpose that the Geological Survey, of which Mr. Beadnell was a member, was originally constituted, and it has been working steadily for many years past in an endeavour to bring to light any mineral resources that lie in those enormous areas. Sinai was one of the original fields in which the Geological Survey started, but it was soon switched off to other parts of Egypt, until the discovery of petroleum on the shores of the Gulf of Suez brought the centre of interest back again towards Sinai.

The existence of petroleum in Egypt has been known for many years. It was known in Roman times. But it is only quite recently—strictly speaking, about 1912—that petroleum was found in quantities of commercial and practical interest. You will understand what great importance the Egyptian Government attaches, and always has attached, to the discovery of this valuable fuel, not only in its own territory but in such an important place as the entrance to the Suez Canal, on one of the main channels of world communication. And when petroleum was discovered there in two places in commercial quantities, the Egyptian Government undertook, and has steadily been working since, to endeavour to throw as much light as possible upon the structure of any area round about in which further supplies might be located. As you doubtless know, this liquid fuel is held in the pores of porous rocks, and unless it has been covered up in some way and held during the ages it escapes, so that in searching for it one looks for the type of structure that is likely to hold it. Deductions are made from surface indications, such as those illustrated in Mr. Beadnell's section, as to the nature of the underlying structure. The Egyptian Government publishes explanatory memoirs dealing with areas in which from surface indications it appears possible that petroleum may be present, so as to make it easier for those who come along to search for such mineral resources still lying hidden in the Earth. I believe I am to be followed by another speaker who has been in more recent touch with the progress of the work and will be able to tell you a little more about it, so I will not detain you any longer.

Mr. T. SUTTON BOWMAN: As a recent and junior colleague of Mr. Beadnell's, I hope I may be allowed to add my congratulations to those which have already been given by higher authorities. Sir Ernest Dowson has introduced the subject of petroleum in Egypt. Turning to Sinai as the more particular subject of the lecture, signs of petroleum are fairly widely scattered through the Cretaceous and Eocene rocks of the more northerly portion of the western side of Sinai. Drilling for oil has been carried out at a fairly large number of places, extending from the great Bitter Lake in the north down the coast to Ras Muhammad, the southern point of Sinai. Unfortunately, these efforts have generally met with a singular lack of success. Only in one place has a small quantity of oil been obtained, and that was by the Egyptian Government at Abu Durba. Soon after liquid was obtained there, the Egyptian Government, for reasons of economy, decided to cease drilling for oil, and the small field was then handed over to an Egyptian company, which is still working there. Unfortunately, the greater number of the bores put down in the search for oil have been north of lat. 28° 40′, and it so happens that north of this approximate latitude the coastal strip of Sinai—that is to say, the strip between the great north-west to south-east fault, which limited the Miocene sea, and the Gulf of Suez—is affected by two systems of folds, the first running north-west to south-east, and the second at right angles to this direction. The result has been that a great number of faults have been developed, and most of the structures which appear promising seem to be so broken up by faults that any oil there may have been has escaped. South of lat. 28° 4′ only the north-west to south-east system of folds seems to affect the country, and I think that prospects might be more promising in that area. Only at Abu Durba and Ras Muhammad has any drilling been done in this southern area, so that the whole strip from Abu Durba to Ras Muhammad has not been tested by drilling, and, as the conditions are more simple there than in the northern area, it is hoped that somebody will prospect there in the future.

FAULTED ROCKS NEAR BIR EL SUWAIR, GULF OF AQABA

GORGES OF WADI MEGEBILA DESCENDING TO GULF OF AQABA

The PRESIDENT: We have a very distinguished authority on Sinai present whose knowledge perhaps is wider than that of anybody else here, extending as it does into other subjects than those we have heard touched on by the three last speakers. I will ask Sir Flinders Petrie to address us.

Sir FLINDERS PETRIE: I would only wish to voice my unlimited appreciation of that magnificent work which Dr. Hume's survey is carrying on, the work of that devoted band who get through an extraordinary amount in the time, and who do some things which seem almost impossible to any one accustomed to less severe conditions. I think, for instance, Dr. Ball's map, in which he planned a large area of the very roughest country, and yet preserved his plans in such a condition that the whole thing could be photographed direct for final publication, is an extraordinary feat—the preservation of the whole of the plans in such perfect condition throughout a rough campaign, that the whole thing can be issued without redrawing or any chance of errors or irregularities. We have seen this evening an example of that devoted work over a most difficult country. I know a little of the difficulties of that country in a few months' work; it is the sort of place in which if you happen to touch a rock it at once takes a piece out of your skin, if not out of your flesh. There are none of the features to which we are accustomed in a moist country; everything seems to consist of nutmeg-graters and sand-paper. To tramp over that country is a feat which takes an enormous amount out of you as well as out of your boots. I know that our party in 1905 had to walk with the lids of biscuit-tins tied round their feet, before they were out of the country. There were no boot-soles left. Again, the difficulties of water are very great, and that alone is a considerable bar to getting about the country. There are whole regions in which one is on the very limit of one's water-tether. That also is a difficulty in Egypt. For instance, there are two ladies working away 15 miles from water at the back of the desert in the Fayum for the sake of the remains of the earliest civilization there, and the whole of their water-supply has to be brought in two motors 15 miles. In Sinai it is impossible to use motors, and in many districts it is not possible to use camels. Therefore the difficulties of handling a region like Sinai far surpass anything we are accustomed to in the ordinary conditions of life, even in various wild countries.

I regret the unfortunate allusion to those recent speculations emanating from Germany with regard to the inscription on the stone tablet: speculations which are absolutely baseless, and which are, I think, troubling us in England to no purpose at all, for we have to reply to many inquiries, and shut down hopes which have been raised in a perfectly futile manner.

Regarding the Exodus record, I travelled the road southward with that in view, and could see nothing at all inapplicable to the exact description. A northward or eastward route would be impossible for the watering of a multitude, and such a proposal is in defiance of the record.

The questions that arise with regard to the antiquities of Sinai are very serious. There are a large number of valuable records still standing there, and liable at any time to injury, both by nature and by man. The earliest monuments of Sinai have been very largely ruined by turquoise miners. One of our party was requested to cut out and bring away all the earliest of the rock inscriptions, and they are now in the Cairo Museum. But there are dozens of monuments still standing which have survived to the present time, but which may at any moment chance in one way or another to come to grief and vanish altogether. I very much wish something could be done towards preserving the remains of man there as well as studying the works of nature. In conclusion,

I can only once more express my great admiration of the work which is being carried out so excellently and continuously by Mr. Beadnell, and in such an active and effective manner.

The PRESIDENT: I hope that what Sir Flinders Petrie has said with regard to the monuments still remaining will be noted. I endorse his view about Dr. Grimme's interpretation of that tablet. It belongs to a class of discovery which, I am afraid, is only too frequent. I remember how, many years ago, a very well-known individual, who claimed to have deciphered the Hittite inscriptions, found none but names of distinguished characters in the Old Testament in the half-dozen Hittite inscriptions with which he dealt!

I think you will agree with me that the result of Mr. Beadnell's extremely interesting paper, of his beautiful photographs, and of the speeches of Sir Ernest Dowson and Mr. Bowman is to show that there is still much to learn about Sinai which is of very considerable interest, quite apart from that which it owes to the disputed events of the Exodus. The Exodus must have passed through some part of Sinai; but it is doubtful whether there is any reason for bringing the Israelites to the south of the peninsula at all. If the great granitic mountains of the south are not to be identified with the mountain of the Law, it is unlikely that the Israelites would have followed any other route than that taken by armies passing from Africa to Asia throughout the centuries. On that route the pipe-line was laid during the war, and on it our advance was made.

That by no means exhausts the interest of Sinai. There were several points in Mr. Beadnell's paper on which one would like to dwell. For instance, on the tantalizingly short notice that he gave of the fauna of the country. I am not so sure that the extreme shyness of the Sinaitic ibex is to be attributed to the over-supply of Sinai with repeating rifles which, as also in Transjordan, took place as a result of the late war. I remember Mr. E. N. Buxton, who with his two daughters made an expedition into the Sinai Peninsula to shoot ibex—he used to go all over the world shooting goats, and nothing but goats—telling me that if he got one in a fortnight he considered he had had rather a good fortnight; the trouble being, as you could see by the photographs, that in the complete absence of cover the ibex, whose vision is quite as good, if not rather better than yours, sees you from an enormous distance. I should have liked to hear more about the other fauna, *e.g.* the leopards and that curious mammal to which Mr. Beadnell referred. It seems an odd country for leopard to frequent in view of the absence of surface water and cover. Mr. Beadnell is one of those travellers who goes into a country with previous knowledge of it and with his eyes open to everything of interest. I am sure you will agree with me in offering him a hearty vote of thanks for an admirable paper and for a still more admirable series of views.

Mr. H. J. L. BEADNELL: It remains only for me to express my appreciation to the President for inviting me to read the paper, my thanks to those who have taken part in the discussion for their very generous remarks, and my gratitude to the audience for the kind interest shown.

THE SURVEYS OF CANADA

Col. H. S. L. Winterbotham, C.M.G., D.S.O.

Read at the Afternoon Meeting of the Society, 15 March 1926.

1. The Topographical Difficulties.

A HASTY but fairly extensive trip through Canada and a much briefer excursion into the United States leave the impression of very restricted views. The atmospheric conditions, at any rate during the early summer, before the smoke from forest fires to some extent spoils them, are perhaps ideal, but there are everywhere, except on the prairies, enormous areas of woods and undergrowth. Could one imagine surveying England in the Saxon period the conditions would have been much the same. It is extremely difficult, often enough, to penetrate the country; more difficult still to obtain suitable views all round. On the prairies, on the other hand, there is easy access but no commanding point, and that very difficult condition of gentle undulation (like parts of the low and middle veldt in Africa) obtains. It will be necessary to go further into one or two well-marked types.

The Central East Laurentian Type.—Going from Ottawa by the C.N.R. to Winnipeg one passes immediately into a region of lake and river. Perhaps more than 30 per cent. of the area is water. The lakes seem in general long and narrowish, following the general easterly and north-easterly drainage, and are connected by rivers or streams. The intervening country is covered with thickish pine and poplar and strewn with boulders. Near water-level large areas are covered with muskeg (a peaty bog). There are very few roads or trails, and summer and winter communication goes on the lakes. The heights throughout immense areas do not exceed 50 feet on the average, with exceptional bluffs up to 200 feet or so. Mineral wealth would seem prevalent, timber rich in places, but communication the difficulty. Historic routes are well enough known, but it is almost incredible how very little is known of the topography in general except to surveyor or prospector. It will be apparent how relatively unimportant in this country is a mapping of relief. Indeed, except where minerals have actually been located it is difficult to see what particular purpose contours would serve, and it is also clear that a V.I. of 20 feet would hardly express the country.

This general type would appear to extend to, or across, the Saint Lawrence in the east and to curve round north of the prairies. In the first case the small bumps grow in significance until on the St. Lawrence, and possibly far to the north, they become definitely mountain chains, which look, from a distance, to provide easy surveying country, but may be entirely, or largely, forest clad. In the second case the rivers and lakes would seem to be much larger and to include much more extensive tracts of muskeg.

The Prairie.—The prairie west of the Great Lakes, the wheat-producing area, shades off to the Laurentian in a bushy and swampy fringe. Itself it varies from an extremely flat monotonous and bare plain to the minor bumps and foothills bordering the Rockies. There are few distinguishable features natural or artificial. Rivers run in deep troughs and tributaries make communication along their banks difficult.

The Rockies.—There is no need to describe these in terms of survey, except to emphasize that rugged sheer profile beside which the Alps appear tame, and the forest covering all that area which in the Alps has developed into cleared and open summer pasturage. Obviously this is the country, *par excellence*, for the photographic methods of Deville and MacArthur.

From Quebec along the St. Lawrence to Montreal, and through Southern Ontario to Toronto.—Settlement has radically altered the look of this prosperous countryside. There are still large areas of scrub and wood. The country is one of undulation, not of hills, and view is still restricted; but there is enough clearing to make it a good and relatively easy plane-table area. It approximates to the Eastern Counties, perhaps particularly to Suffolk.

The Maritime Provinces and British Columbia.—Unfortunately I saw nothing of either, but from hearsay and from maps, I should think it sound to assume that east and west are alike mountainous and forest-clad, but that the west is much higher in relief, less intricate in drainage, and more heavily afforested, than the east. In the maritime provinces there are many artificial points (churches, chimneys, etc.), and occasional easy surveying country; but, generally speaking, the difficulties of view and communication are marked.

2. Land Registration.

It is always interesting to note the interplay of cadastral and topographical surveying. One cannot imagine a case in which the two are not intimately connected and could be of the utmost value to each other. Perhaps Great Britain, with its almost universally topographical definition of property, stands rather apart. Elsewhere, and particularly in the older Crown Colonies, one is generally confronted with independent departments, overlapping responsibility, shaky titles, and poor maps. In Egypt, it would seem, we have nearly the ideal, and in the Gold Coast an excellent start; but in those countries, as in the good cadastral surveys of Germany and the late Austrian Empire, one has to deal with existing and irregular land division and titles. In Canada and the United States the settlement of vast tracts of empty country presented a different problem and has been answered in interesting fashion.

Before mentioning the "Prairie" system, however, it may be as well to say a word as to property surveys in the provinces. On the eastern seaboard settlement surveys would appear to rest principally on

LAKE AND FOREST OF LAURENTIAN TYPE

PRAIRIE OF SOUTHERN ALBERTA

the compass. These surveys were originally somewhat crude. Perhaps Penns' questionable methods of securing a concession (which found their counterpart in early South African Farm surveys) did not actually obtain, but in any case it is not found easy to reconcile them with modern cadastral or topographical measurement. Areas are of no general pattern, and have been subdivided for sale or by inheritance.

In smallish and definite areas such as Prince Edward's Island land settlement appears to be fairly complete and no doubt satisfactory. In Newfoundland I understand that there is difficulty of title, due to faulty survey.

In Quebec, lower Ontario, and occasionally elsewhere (as at Selkirk, near Winnipeg), the French river frontage and narrow extension in depth obtains. The Seigneury has definite limits of this sort, is divided into farms, and is separately shown on its "plan de Cadastre." The older "plans" are, I understand, of questionable accuracy, and show no topography.

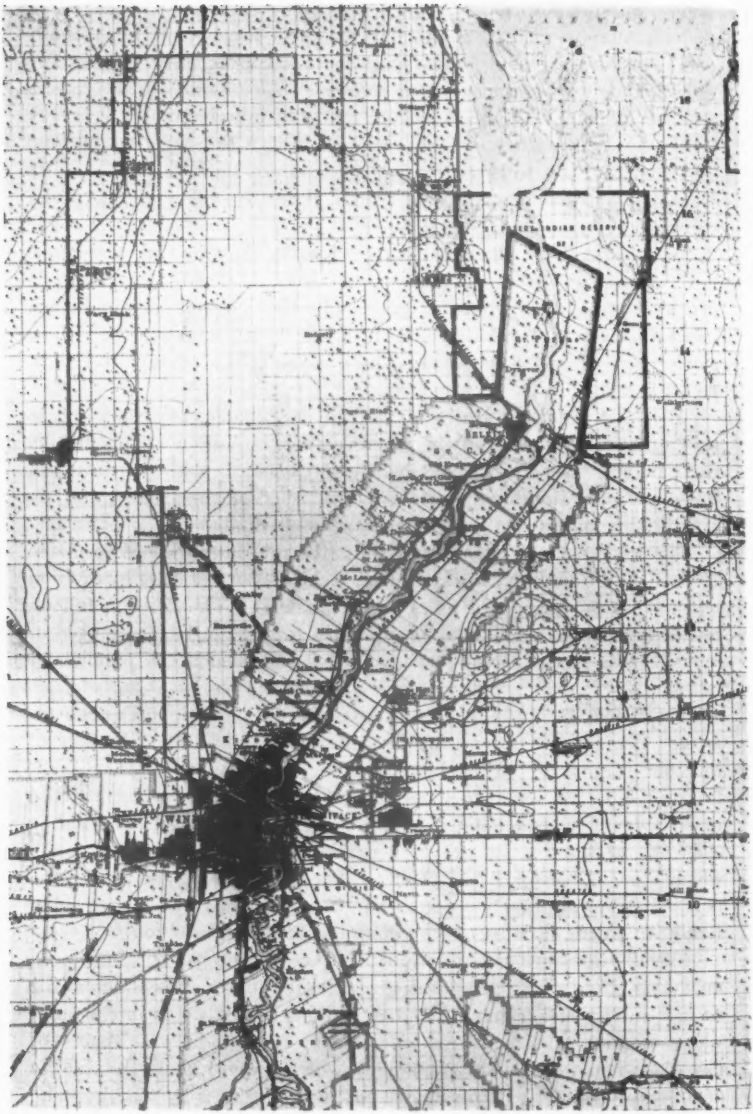
The later cadastres are better and, it is probable, are connected to points of the Geodetic Survey, wherever possible, or to astronomically fixed points. Generally speaking these cadastral plans, British and French, are not suitably or permanently marked on the ground, and are of little value to the eventual production of a national map.

The settlement of Dominion Lands (the prairie purchased from the Hudson Bay Company) was, however, tackled systematically by division into townships (36 square miles approximately). The division follows two or three main meridians, lines parallel to these meridians jogged at intervals to give the necessary convergency and elements of parallels of latitude.

These lines are actually cut or marked on the ground, and settlement is thus definitely in pre-arranged geographical lots. The accuracy of this enormous survey will be mentioned later, but meanwhile it is sufficient to point out that we have here an existing control on which to base topographical mapping, and a system of reference which, if not ideal, is efficient and in universal use. The details can be studied in a manual * which is available for those who are interested therein, and it is to be noted that the original 3 miles to 1 inch maps issued by the Dominion Land Survey are little more than diagrams of this subdivision.

This division of the country into arbitrary squares has of course been much criticized. It is thought that its defining lines must cut across the natural subdivision of nature. They certainly would do so in England, where creation was in microscopic mood; but in the vast spaces of Canada, where individual types hold so wide a sway, I doubt the validity of this argument. It is considered, too, that distances by road must be annoyingly increased thereby. There may be something in that, but not

* "Manual of Instructions for the Survey of Dominion Lands." Ninth Edition. Ottawa, 1918.



RIVER FRONTAGE LAND SETTLEMENT SURROUNDED BY DOMINION LANDS SYSTEM

very much of importance in a country where the plumber arrives in his own car. Surface is more important than distance.

The real drawback seems to me to lie in the fact that a system which provides for the most economical use of haulage and transport on the farm, *ipso facto* removes one's neighbours to the maximum distance.

In reality it is a compromise we are considering—a compromise between the ideal topographical division into farms, and the division possible to survey and arrange in advance. It seems to me to constitute a very reasonable answer, and the township survey to be an interesting example of a big undertaking boldly and resolutely carried through.

3. Canadian Geodetic Methods.

The up-to-date and efficient geodetic survey of Canada is familiar enough to us, not only from the yearly reports but from personal acquaintance (at Madrid and at the R.G.S.) with Mr. Ogilvie. There remains little to say. It is apparent that in order to give a reasonably accurate framework for topographical mapping for engineering development and for large-scale town mapping a geodetic skeleton is essential. Both in making such a skeleton and in providing precise levels this survey is making steady progress in face of relatively small revenue. In the future much practical advice and assistance will be available for other British geodetic surveys from Canada, and it seems to me most desirable that a better system of imperial exchange of geodetic reports and information should be evolved. There are special problems involved in the junction with the American Coast and Geodetic Surveys, and in the consideration of matter which has already been adjusted and readjusted to the constantly expanding American skeleton.

There has been some thought, I have heard, of trying the American precise traverse (along railways) in lieu of the much more useful chain of triangulation. In certain cases nature may impose such a lapse from the ideal, but geodesy and topography will alike be the losers.

A great deal of attention is paid to instrument construction. British surveyors will be interested to know that Canada has a Wild theodolite, which has been in use this summer. A report on it has been given me very kindly by Mr. Ogilvie, and it is stated that no trouble has been found in practical work in the field, that the instrument has stood up to all demands, and that it is only in the resolving power of the telescope that it has not proved up to specification.

The Geodetic Survey has its own invar tapes and, very wisely, does its own comparisons. The tapes, 150 feet long, and supported in the centre, are tested under field conditions by the observers who actually measure the bases.

The Geodetic Survey has strong computing and instrumental branches. The former is of course common in all Survey departments, but the latter is a very useful thing somewhat novel to us. There is, I fancy, a

considerable interplay between this instrumental branch and the laboratory of the topographical department.

The Geodetic Survey acts as the central bureau for all levelling in Canada, although itself confined to precise field work. All other departments pass their levelling results to the Geodetic for incorporation in the general scheme. The Geodetic Survey is also doing an interesting large-scale map of London (Ont.). It will be enlightening to hear of the cost of this survey, and a little more as to the actual field work.

4. Topographical Methods.

Canadian, American, German, and Italian topographical methods are very different from our own. Had we, like others, developed overlapping cadastral and topographical surveys instead of reducing from the 25-inch, we might, for medium-scale surveys in England, have developed in the same way. As it is, our methods of making small-scale topographical maps in India and the Crown Colonies have developed for that particular purpose, and are not evolved as they have been elsewhere from medium-scale or engineer surveying.

American survey literature and American practice in war mapping has made us familiar enough with the almost universal traverse, the omission of graphic interpolation, "cutting in," or intersection, and the party of one skilled man and several labourers characteristic of these methods. The theodolite serves little purpose except to record the angles between successive measured lengths. The rear tape man is the most important traverse hand. But it must be remembered that the factors peculiar to North America make for such methods. In the first place the view for theodolite and plane-table is very restricted, and in the second place intelligent but unskilled labour is available in the shape of university students in their summer vacation. Instrumental methods are the most natural with such material. It is doubtful to what degree more ordinary topographic methods would apply.

There is no question, of course, that these lads bring a high order of intelligence to bear on their temporary duties. If any one doubt it let him join a surveyors' camp, and listen, in the intervals of swatting flies, to conversation on the future of the Empire, the knotty question of race, or the League of Nations. The comments of that bountiful person, the cook—old soldier or sailor and past master of human nature—are well worth attention also. But topographical surveying is of course an art rather than a science.

5. The Geographical Section.

The policy adopted by the General Staff is entirely in line with our own. The 1-inch scale has been chosen for publication, and the actual topography is done at 2 inches to the mile. The sheets already published lie along or near the frontier.

On occasion points of the geodetic survey are available on which to

tie. Even if so, however, a fairly extensive control is added in the form of road traverses. The control party consists of seven men in two groups ; of which the first (five in number) consists of front and rear picket men, a "transit" man, and two chainmen. Distances are taped in one direction only, and from 12 to 15 miles are done in a day. These traverses are closed and generally tied in by cross lines. The closing error is of the general order $1/2000\sqrt{d}$ (where d is the distance in miles).

During the traverse a certain number of upstanding points in the area to be mapped are intersected. During the minor (or interior) traverses two men drop out to form a second level party (in addition to that already provided for by the two men unaccounted for). The level party (surface levelling, no bench marks) do about three-quarters of the distance of the traverse party. This control is then plotted on plane-tables and given to the plane-tablers, who are organized in groups, each with its superintendent. The plane-tablers are either old Ordnance Survey men or are taught by them. The graphic control is pushed into the area from the road traverse, and the detail (mostly on the roads) largely put in by distance (along the traverse) and offset.

Contouring is done with the Indian clinometer. Each sheet is then examined carefully in the field, and the road classification completed by the examiner. The latter then returns the sheet to the group superintendent, who attends to the remarks and corrections, compares edges, and forwards to the office. The procedure is well arranged, methodical, and bears the stamp of that honesty characteristic of O.S. method.

There is no time to go into details of photography or printing, or else special mention would be necessary here of the very efficient map reproduction of this section. The maps now being turned out are first-class productions in every way.

6. The Boundary Commission Surveys.

No description of the surveys of Canada could be complete without reference to Boundary Commission work. Demarcation is complete, and the maps which illustrate it are practically all published, nicely enough, at Washington.

The methods employed, photographic or tachymetric, are those described later. It was not possible to see any of the field work, but it is obvious that the survey from Cape Muzon to Mount St. Elias must have involved peculiar difficulties of transport and topography.

7. The Topographical Department.

The topographical department is the old Dominion Land Survey. Its primary duty did lie in that land division of the prairies which has been already described and of which the lines were laid out, and cut, from theodolite and tape work. The main meridian and certain important parallels were surveyed with particular care. A line along the parallel of 150 miles would, for example close on the meridian to something

like 200 to 300 feet. The errors of closing were put into the last township side (6 miles), giving errors of the order of 1 part in 150. Main lines of levels were then run along the more important meridians and parallels, along railways and perhaps along such old "trails" as cross the country from point to point. It will be noted that this is all instrumental rather than topographical. In the Laurentian country, not generally cut up into townships, a certain amount of mapping follows on a control of lake and river traverse, based on astronomically fixed points, lying about 200 to 300 miles apart. The intermediate traverses are carried from point to point along lake and river by rangefinder or tachymeter in shots of the order of half a mile. The accuracy of this traverse would be about $1/200\sqrt{d}$ (where d is the distance in miles). Astronomical observation should not (probably) include much error for the deviation of the plumb-line in a uniform region of little elevation, and probably 400 feet would be a largish error for the astronomical control. If topography is to be added (including *only* the outlines of lakes and rivers) more stadia work is required. For simple control 10 miles a day is normal; for topography also one-third to one-half of that amount. Points are marked by stone or wooden pillars, and frequent azimuths are observed.

We English surveyors are accustomed to think of stellar observation as possible only after sundown, and of "east and west" stars as best for time. In the clear air of Canada, however, it seems to be generally possible to observe Polaris and circumpolar stars whilst opaque signals are still visible. We can but envy our Canadian opposite numbers. Deville considered that the night was meant for repose, and surely he was right.

The third task of the Dominion Land Surveyor was the ground photo-topography in the Rockies. It will be seen that the Dominion Land Surveyor had no great need in the past to be a topographer. It is probable that most of them were so by instinct. Without exception those that I met were intrepid explorers, and had personal records of northern travel and exploration extending over many years. One such told me that he had had a house for twenty-six years and did not know what the grass was like in his garden, for he never saw it save in brief winter visits.

The position has now changed. The division of Crown lands is largely complete, the very title of the department has been altered, and mapping is becoming a live subject.

In the Laurentian type of country air-photo surveying is almost inevitable. Thanks to the cordial cooperation of all concerned and to the knowledge of photographic method so characteristic of Canada, this area is being begun in a thoroughly economical fashion which will be dealt with later.

In the prairies the position is just as interesting. Photographs cannot be made available everywhere, and ground methods are also being

used. The control defined by the land settlement lines is accepted, plotted, and issued at an enlarged scale. In the field the lines of levels are amplified by stadia levels so as to cover the perimeter of the area with a grid of points at about half-mile distances. Detail is mainly on the roads (homesteads, etc.), and is filled in by speedometer traverse and offset. Subsidiary heights are fixed by barometer, and contours are then sketched in. The map is reproduced at the old scale of 3 miles to 1 inch (probably chosen by Deville as being nearest to the French 1/200,000). A whole township (36 square miles) is completed per diem by the party of six (four surveyors and levellers and two car-drivers). The progress made is thus astonishing.

Now, to consider first the control one must admit that it is not ideal, but it exists and is well marked on the ground. Moreover, at present there is but little detail far from the roads. In the circumstances one cannot but concur in the wisdom of the method. The barometric control is very interesting. The Topographical department have taken considerable pains to improve the design of their barometers. A very efficient laboratory deals with this and kindred subjects. Barometers are used in batteries of three, each field hand using a separate battery, while a spare one is kept in camp and read at hourly intervals. The readings of those barometers taken out into the field are then corrected by the gradient established by the stationary battery. From the records I saw I do not think that errors of more than 5 feet arise.

It seems to me that in the main these methods are so practical and follow so logically on the land division that they are inevitable at the moment. They will serve, in fact, for the 3-miles-to-1-inch scale, and in flattish country. On the other hand, for 1-inch work and for areas like the Calgary foothills, I am certain that the plane-table and Indian clinometer as used by the Geographical Section would prove the right answer (the Geographical Section traverse control being replaced, of course, by land division). In the maritime provinces, again, and wherever no actual traverse control or township lines exist to complicate the issue, normal theodolite and plane-table methods will be found the best even if, at first, they come hard to those unused to them.

The methods of ground photo-topography employed are still more or less the same as those described by Deville. A pamphlet on "Photographic Surveying" by M. P. Bridgland, D.L.S. (Bulletin No. 56, 1924), gives the present practice. The 1-inch maps round Banff are certainly very good, and there is no doubt that the Boundary Commission surveys are equally good examples of the advantage of photographic method. But there remain, of course, those difficulties of identification and of getting a complete double view which are characteristic.

The Topographical Survey has drawing, photographic, litho printing, topographical, model, legal (land settlement), land classification, map store and sales, and laboratory departments. The latter includes another

bar-and-tape room which is most efficient, but is not so long as that of the Geodetic. All these sub-departments are obviously well organized.

8. The Geological Survey.

The Geological Survey also does topography. Unfortunately I did not see Mr. Boyd, who is, I understand, responsible for this work. The maps turned out are obviously good productions, and I believe the methods are analogous to those of the Geographical Section. As a general rule one supervisor and from three to five younger men (some, I understand, of little previous experience) do an area of 15 minutes square in a field season. Owing to the lack of funds contours are not, it was stated, to be surveyed in the future, except in the Rockies. Spot heights will however be given.

9. Air Photo-Topography.

(*a*) *Canadian Organization.*—The R.C.A.F. is under the Department of National Defence. It has its military duties to perform and its training to carry out, but it performs, in addition, those other national tasks in photography, forest patrolling, etc., with which reports have familiarized us. Votes for upkeep are now warmly supported by the departments concerned in these activities, whilst the value of the training in airmanship, for those who may come down on a lake whose existence had never even been recorded, or return to a field on the prairie, and to whom good navigation and a trained eye for searching country are essential, can hardly be overestimated.

For these civil purposes, however, there are in addition civil flying bodies. Ontario has its own provincial airmen. Quebec gives out its special air requirements to contract. There is also a Canadian Fairchild Company. As far as Government mapping is concerned, however, it may be said that all air arrangements pass through R.C.A.F. headquarters. The negatives taken pass from thence to the survey department concerned.

Before leaving the subject of organization, I should like to record that exceptionally close touch and mutual understanding between airman and surveyor which exist in Canada as, I think, hardly anywhere else. Surveyors fly regularly in the " boats " used in the lake districts, and airmen are concentrating on problems of navigation. There is everywhere the keenest interest in method and instrument and a marked absence of that sloppy over-confidence or wilful pessimism we have seen sometimes elsewhere in airman and surveyor respectively.

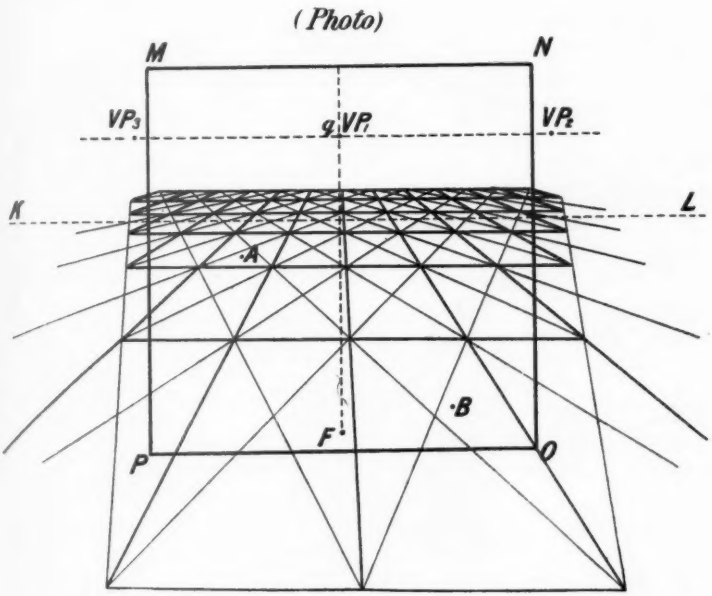
(*b*) *Survey Requirements.*—It stands to reason that in Canada the main task is small-scale mapping (1 inch and under). Engineering enterprises occasionally want medium or large-scale surveys, but these are for private concerns, and are separately dealt with. The methods involved must then be very simple, and there is no call at present for those accurate but expensive instruments necessary to larger-scale work.

BOOM LAKE: ROCKY MOUNTAINS, ALBERTA

VANCOUVER CITY

(*c*) *Oblique Photography*.—There is no more to be said about the theory of this method, but there are interesting points of practice. During the war experiments aimed at photographing the horizon definitely failed. We have failed too in England. But in Canada, on the average, the horizon can be photographed from 5000 feet on two days per week. Naturally the method is only applicable for mapping water surfaces or very flat country, but it would be enormously useful in the Sudan or Mesopotamia, etc., if it is found possible.

It is difficult to grasp the considerable accuracy of the method.

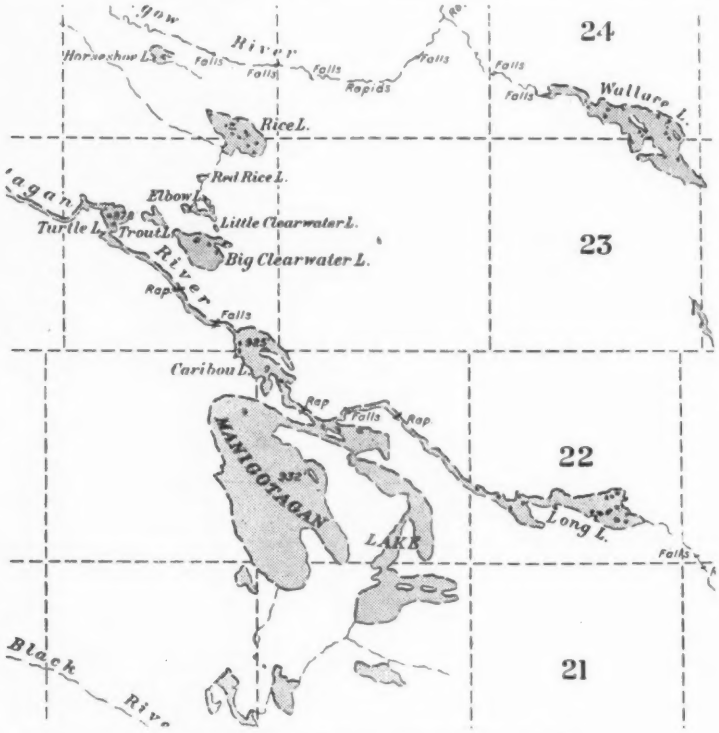


Derivation of grid on an oblique photograph from the township lines of the Dominion Lands surveys; or alternatively from photograph of horizon and two control points.

Recently two photo-traverses extended from known points without further control for 150 miles and 75 miles respectively, joined with an error of about 1/150, and of course, much of this might be attributable to a control which is not of a very much higher order. The plotting is very quick and the whole performance relatively cheap, although I am not able to quote exact figures. Questions of the cameras, aeroplane design, and view will be mentioned later.

(*d*) *Vertical Photography on the Prairies*.—I had not grasped, before I saw it in practice, that the Dominion Land Survey (the outlines of townships, etc.) provides an immediate key between photograph and map. There can be no difficulty therefore in plotting from these verticals,

and there is not much difficulty normally in the navigation of the plane. The township lines may be seen and followed across country for miles. There are, however, occasions where the timber in the cut lines has grown up again fairly tall, and others in poor land or Indian reserve where they were never cut at all. Then, too, the township lines are far enough apart to make an intermediate line of photography necessary. These difficulties are however small compared with those of good navigation over ordinary country, and do not forbid extraordinarily good and



Portion of the "Oiseau" sheet: original edition: 1/190,080.

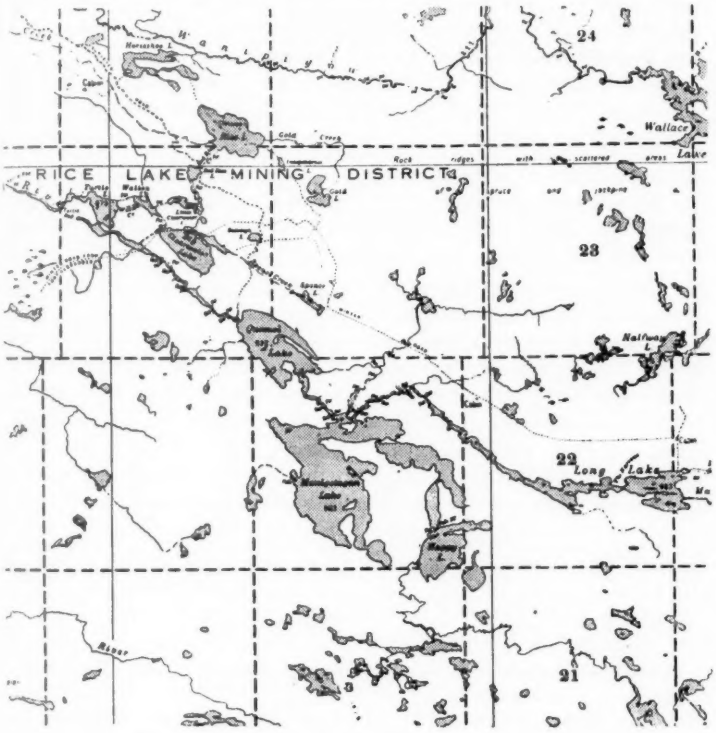
straight flying. Lines of 90 miles are sometimes flown, and an examination of "overlaps" shows how steadily height (and therefore scale) are maintained, and how successfully tilt is avoided.

The two main points for future consideration seem height and focal length. In gaining great height naturally time is wasted, and moreover good weather conditions are harder to get. On the other hand, as much area as possible is required in each photograph. A much wider angular field is required, but the exposure can certainly not be lengthened because

of the relatively faster angular motion when flying low. More sensitive films and a stopped-down lens *might* help, but better lenses might in any case be found.

The prairie photographs are mounted in groups of two or three and sent to the field surveyors for topographical revision or for land valuation.

Vertical Photography in Ontario.—Photographs have been taken for the Geographical Section in lower Ontario. There the township lines do not exist in the same way or form as in the prairies. Navigation has



Portion of the " Oiseau " sheet re-compiled from Aerial Photographs.

not been too easy in consequence, and indifferent sets of photographs have been given. The usual traverse control is first plotted at 2 inches to the mile, and the detail added from photographs. The plotted detail is then revised and contoured on the ground. This survey calls for little comment, but emphasizes the need for navigation instruments in the aeroplane.

(*e*) *Land Classification.*—Maps showing land classification and soil analysis are not familiar to us, but are interesting, and must be most valuable. The photograph is of course invaluable for the purpose.

It would appear that a certain loss of capital, and also of attraction to possible settlers, has resulted from grants of unsuitable land. The Topographical Survey are therefore preparing maps of considerable areas on which the value of the land for settlement is shown. The value depends on various factors, two of which are the actual analysis of soil (quickly and personally carried out in the field) and the amount of clearing which is required. The photograph naturally discloses bush and swamp, and by interpretation on the ground gives the outline of areas of different characteristics. The surveyors occasionally turn over the soil also. The outstanding factors are obviously the personal knowledge of the surveyor and the information contained on the photograph.

Quite obviously this classification can be carried out simultaneously with contouring and examining topographical detail on the photographs in the field.

10. Conclusion.

It is unfortunate that neither my visit to Canada nor the space of this lecture has allowed of touch with the provincial surveys. British Columbia, for example, turns out some very creditable maps. The visit itself leaves behind it the memory of extraordinary kindness and hospitality from public department and private individual.

Perhaps the deepest impression is that of the amount we surveyors in the Empire can, and should, learn from each other. International conferences are broadening, of course, but how much more profitable would be a conference of British surveyors fresh from all quarters of the globe and every sort of surveying problem! One may, painfully, keep abreast of Continental practice from this or that periodical, but how much more useful a really good Empire surveyors' monthly!

Before the paper the PRESIDENT (Dr. D. G. HOGARTH) said: We are going this afternoon to listen to Colonel Winterbotham on the Canadian Survey. He has recently returned from Canada and has informed himself, by a rapid view, of what has been done in that country. I think you will find that he covered the ground, and that his account will be interesting.

Col. Winterbotham then read the paper printed above, and a discussion followed.

Col. E. M. JACK (Director-General, Ordnance Survey): Col. Winterbotham has given us an extraordinarily interesting address. He has shown, as usual, that he is able to master a subject completely in a very short time. The point that strikes one most in the clear picture that he has given of the Canadian Survey—a large subject to deal with in a short time—is the very great difficulties that Canada has to overcome, apart from the enormous extent of the country; physical difficulties and those of a rapidly developing country, and those also that must arise—they cannot help it, even with the best will in the world—from having a number of survey departments more or less independent. Col. Winterbotham has shown that there is likely to be increased coordination in the future, and I am sure that will be all to the good.

The lecturer has cited many interesting technical points: the methods

that the Canadians have evolved for dealing with their own peculiar conditions, which it is rather too late to deal with at this hour. The most interesting thing, of course, in the Canadian Survey is the great development of photographic survey. Col. Winterbotham has shown what a great amount can be done in that way, and there is no doubt that we must look to Canada for our chief developments in that direction.

Col. C. H. D. RYDER: I did not come prepared to join in this discussion. I find there is one difficulty in doing so, and that is if I am asked to join in a discussion I like to hear a lecture in the course of which I disagree with something. I listened very attentively to Col. Winterbotham's lecture, and I cannot think of anything with which I disagree. It was very clearly put, and opened up a very interesting bit of country which by its enormous size is, of course, quite a different thing altogether to what we are accustomed in England. We may do all sorts of large-scale surveys and so on in England, but they would all be swamped in one of the Canadian lakes. In India we have a longer history of surveying. We have been at it for many more years than the Canadians. Really, the Canadian Survey is one of very modern origin.

The only thing I do not like about the Canadian Survey is their adherence to the photographic method. I do not mean the air-photo—of that I am a strong advocate—but the ordinary photographic method. My experience is that it is very slow. We could not possibly use it, for instance, in India because it has to be done by men of fairly highly technical qualification, and my great objection to it is that no portion of the map is ready on the ground. We had an instance of that in the first expedition to Mount Everest. Major Wheeler, one of my officers and whose father was one of the surveyors in Canada, was a keen advocate of the photographic method. I must admit he over-persuaded me, and he took up an apparatus. The final result was all right, but it took months to prepare, and he was not able to supply the members of the expedition with a map ready at the time. Otherwise I think we have got a lot to learn from Canadian surveys, and I think you will agree with me that Col. Winterbotham has placed the subject before us in a most interesting and very charming manner.

Col. H. L. CROSTHWAIT: I associate myself with previous speakers as to the interest which the lecture has been to us all. Two points interested me especially. I understand those townships are laid out along meridians and parallels. But as one went north the areas would not be the same. In India we had the same kind of problem, and in order to avoid convergency our squares, or rather rectangles, were laid out on the ground in conjunction with triangulation. Chains of triangles ran along suitable lines, and the coordinates of the rectangles were computed and they were laid out on the ground, so that all the areas were exactly the same. The settlers received exactly the same amount of land, and there was no question of dispute afterwards as to the area, as there had been before the Survey of India took up this question, which had caused a great deal of friction among the different colonists.

There was one other point: the use of the telescopic alidade. Col. Winterbotham seemed to deprecate the use of the instrument, but I believe it was very largely used by the late Col. Pearson in Egypt, and we also tried it in India. I cannot say we used it very much, but I believed at that time there was great possibility in this form of alidade—I think I am right in saying that that is what Col. Winterbotham refers to—which also had a tachymetric arrangement. The beautiful Swiss plane-table sections are carried out with this instrument.

Dr. BISHOP: I was very relieved to hear Col. Winterbotham refer to a

theodolite as a transit. I read in the *Geographical Journal* that it was heresy to call it a transit. It may be; but a good many refer to it thus. I do not know very much about the part of the world Col. Winterbotham has been describing, namely, the prairie. I come from British Columbia, where conditions are different, partly owing to physical features. There are a tremendous number of mountains there divided by parallel valleys, and we do not have the same large system of control. A certain number of meridians and parallels have been run on the Dominion system with squares every 24 miles in the railway belt, and in the rest of the country under the control of the Provincial Government a few meridians and parallels have been run at intervals of about 70 miles. This has not been altogether a success, and most of the control is now done by triangulation. The need there was not so much to have an extensive system of control as to cut up the lands into narrow belts ready for the settlers to go in, and there the old-timers fifty years ago found that the cost of a transit survey was absolutely prohibitive. So they had to make compass surveys. I hope there were not quite so many broken needles as Col. Winterbotham said. We also had a great deal of trouble with the local attraction, because there is a lot of iron in the soil there. I have occasionally been running a compass line and noticed that the line, which was supposed to be due south, would be about S. 20° W. Now all the surveys are done by transit—or rather theodolite!

The other great difficulty, to which Col. Jack referred, is the fact that there are various Survey Departments. I think the Provincial Government in British Columbia does very much more than the other Provincial Governments, and this is due to the fact that when British Columbia became a federation it retained control over its own national resources. I believe the British North America Act did not provide for a general survey of the country, but merely for a geological survey of Canada, which, of course, is only done in patches, and in order to administer its own natural resources British Columbia has been obliged to do a tremendous amount of surveying on its own account. But now, owing to the very enlightened policy of those in charge of the Dominion and the provinces, there is very much more coordination between the two surveys and not so much waste of money as there used to be.

The PRESIDENT: Has any one anything else to add, or any question to ask Col. Winterbotham before he replies?

Sir CHARLES GALE: Has Canada a regular Dominion Survey similar to the Survey of India, for instance; or do all the different provinces have their own surveys and work entirely separately? I could not make that out from the lecture.

Mr. A. R. HINKS: I think, Sir, it is not really a very serious heresy to call a theodolite—which, after all, is a good word—a "transit" unless it leads one into the really serious heresy of using it as a transit instrument in an astronomical sense. I think we should all agree that the theodolite should not be used as a transit instrument, as is done, apparently, in the Massachussetts Institute of Technology, according to the review of a book to which reference has been made.

I should like to remark upon the value of Col. Winterbotham's early admirable photographs, as illustration of a point which has always interested me, and which I got into trouble about last year when I remarked that it would make a good subject for discussion, how far cutting up a country into squares had done permanent damage which nothing whatever could eradicate. It is too large a subject to go into at this stage, but I would like to call attention to

a letter, which perhaps I may be allowed to publish in the discussion as printed in the *Journal*, from a surveyor in Canada. He points out that people have become so used to having their country cut up into squares irrespective of topography that when a more enlightened system was adopted deliberately by one of the Canadian railways, the country had to be re-surveyed, because the farmer thought he had not a proper farm unless it was square!

Col. WINTERBOTHAM: I will answer, first of all, with regard to the scope of the Survey Departments. The Dominion Land Survey of Canada was started to do the Settlement Survey of the prairie region which in the old days belonged to the Hudson's Bay Company. It was purchased by Canada, and became therefore Dominion land over which the topographical survey has official significance. The Geodetic and Geological Surveys work over all the Dominion, but the maritime provinces and British Columbia do their own topography.

There were two other points to which I should like to reply. One is the question of the telescopic alidade. The best illustration I can give of its value to the topographer is that we had 137 telescopic alidades issued for service in France during the war. At the close of the war we returned 136 in perfect order! The fact is that the average surveyor, whilst he recognizes that theoretically it is an excellent instrument, in practice, he does not want it if his forerunner, the theodolite observer, is a man who knows his job. If the theodolite is properly used the plane-tabler will never have to look so far for his "points" as to need a telescope. I speak here with diffidence, because Col. Ryder, recent Surveyor-General in India, knows so much about the practical needs of the plane-tabler.

Another question was that connected with the convergency of the meridians in the Dominion Land Survey. In the prairies the question is not to lay out a square, but to give an area. There are only three main meridians, I think. The other north and south lines are cut parallel to the meridians, but occasionally jogged, and then carried up again parallel so as to allow of the convergency.

The PRESIDENT: Various speakers much more qualified than myself have already expressed the great pleasure that Col. Winterbotham's paper has given them, and I am not fool enough to try and rush into a field in which so many angels have feared to tread. As a mere layman I was particularly interested in the point that Mr. Hinks raised. It had occurred to me, as I looked at that cutting through the forest, that it must have some curious after-effect upon the scenery, and I was a little relieved to hear that Nature is already taking her revenge, and that except from the air it is now difficult to see where the lines had been cut twenty years ago. Possibly such squaring of a country has some depressing effect upon the ethics and manner of people in it; but I would point out that though Alexandria was laid out by Alexander the Great on the grid-iron principle, as were also all the great cities of the Hellenistic period, yet the people who lived in them remained comparatively civilized; which sometimes comforts me when I have visited American cities and wondered whether anything good could come out of places laid out so regularly in blocks. I would only convey to Col. Winterbotham, in your name, our grateful thanks for an extraordinarily interesting, at times humorous, and at all times illuminating and lively discourse upon a subject which did not appear, when we heard it announced, likely to produce such a result. There was a good deal that was extremely human in the whole subject and the way in which he put it. I hope you will express your thanks in the usual way.

Note added by the Secretary.

In acknowledging last August the receipt of the Banff sheet of the 3 miles to 1 inch map, the Secretary R.G.S. wrote to the Surveyor-General, Topographical Survey of Canada, that the sheet "is not only interesting as an example of topographical mapping but also raises the question upon which I have often sought an answer, namely, how much permanent damage is done to a country by cutting it up into squares? It is easy to see that the roads north of Calgary are laid out without much regard to the topography, and this must, one would think, be a permanent disadvantage; but I have never seen the matter discussed frankly, and believe that it would be of some interest to do so. The system evidently breaks down directly you get into the mountains, although the squaring is carried right across them. Can you perhaps direct me to any publication in which the original reasons for cutting up the country like this and the advantages of it are clearly set out, so that one can appreciate both sides of the question? It is the disadvantages which are conspicuous to an observer from a distance."

We take leave to publish the very interesting letter, with extracts from an article by Dr. Deville, which Mr. F. H. Peters kindly sent in reply.

"The system was originally designed for the very extensive areas of country with low relief in Western Canada, and, apart from the merit of rectangular farm units, has the advantage of making available for disposal a maximum number of parcels of land at a minimum cost of survey. The demand for additional land for settlement varies with the rate of colonization, but the appropriation of public moneys for surveys is always difficult to obtain, and these two factors have precluded the possibility of undertaking a more elaborate system of surveys in areas of greater relief.

"The rectangular system, however, does not work a permanent disadvantage in rough country. As settlement intensifies and the wealth of the community increases the natural routes of transportation which have been selected by the early settlers are acquired by the municipalities and improved as public highways in place of the regular road allowances laid out in the original survey. Provision is made for this in the Dominion Lands Act and the provincial Land Titles Acts. In the Railway belt of British Columbia no road allowances whatever are laid out in the original survey, but the size of each quarter section is increased to 163 acres to provide for future roads, which are located in consideration of the topography.

"Not much has been written on the subject, but the following is an extract from an article on radial hamlet colonization schemes written by Dr. E. Deville, late Surveyor-General, in 1917.

"'The Dominion Government has never departed much from the square plan; the parishes and settlements along the Red, Assiniboine, and other rivers were laid out by the Hudson's Bay Company prior to the acquisition of Rupert's Land by Canada. The only attempt to introduce a modification was in the early 'eighties, when the lands on the South Saskatchewan, Red Deer, and Battle rivers were being surveyed. It is obvious that a quarter-section cut into two parts by a large river is not convenient for working as a farm; on the other hand, a river frontage is an advantage. The sections fronting on these rivers were accordingly divided into river lots a quarter of a mile wide and a mile deep.

"'Advanced thought does not favour planning by geometrical rule. It is held that the subdivisions of a tract of land must be located where they will be of most service, where grades are light and the soil suitable, and that every

local feature must receive due consideration in devising the general scheme. There is only one instance of a subdivision of this kind in Canada ; it is in one of the C. P. R. irrigated townships in Southern Alberta. The Company having invested eighteen millions in the irrigation works considered that they might as well spend a little more money to alter the subdivision in conformity with modern ideas and have everything as perfect as possible. They selected a township badly cut up by irrigation ditches where the need of a readjustment of the subdivisions was obvious ; they made an elaborate planning of the land, laying out each farm so as to best meet the requirements of the farmers. They next proceeded to fill it with selected farmers, some from Alberta and some from the United States. To the astonishment of the Company, these farmers took in preference the lands in the adjoining townships divided into squares, and it was not until all these lands were taken that the scientifically laid out township was filled in.

" ' The Dominion Government had no more luck with its river lots. Such a storm of protest came from the west that they had to be unsurveyed, except those that had been disposed of, and turned into quarter-sections. The protest was unreasonable, because a quarter of a mile by a mile is a good shape for a farm, better than most of the farms in Ontario. It is also pertinent to remark that, notwithstanding his enthusiasm, Sir William Van Horne never tried his scheme, although he had twenty-five millions of acres at his disposal ; he must have been satisfied that it would not prove successful. It is difficult to avoid the conclusion that the man behind the plough wants his farm to be square. He may be deluded, but until he changes his mind, the prospects of a departure from the square farm are remote.' "

THE WESTERN GONJA (BOLE) DISTRICT OF THE NORTHERN TERRITORIES OF THE GOLD COAST

C. St. B. Shields, Assistant District Commissioner

Folding Map follows page 480.

THE area of the Northern Territories with which this article deals is immediately over the northern boundary of Ashanti. It is 120 miles long by 70 miles wide and has a population of ten thousand, that is, about 1·3 people to the square mile. It is reached from Kumasi by two routes. That most usually followed is by motor to Ejura and Yeji, across the Volta by ferry, and on to Salaga and Tamale, whence one proceeds on foot or by hammock to Daboya. Crossing the White Volta one follows the old trade route from the north-east to Larabanga, and through Senyon to Bole town, the headquarters of the district. The total distance is 370 miles.

The shorter road, 260 miles, is by car to Kintampo *viâ* N'Koranza, and from there on foot to Dwere, where one crosses the Black Volta and continues northward on the main road from Kumasi to Wa and the north. In the latter case the journey takes a minimum of nine days and in the former twelve. Horses cannot be used on any part of the journey or in any part of the district on account of the tsetse fly.

The district* is bounded on the south and west by the Black Volta, which also forms the frontier between it and the north of the Ivory Coast, and the south of Haut Senegal. On the east the boundary is for some miles the river Labani, after which there is no very definite division between the district and that of Salaga till the river Mori is reached on the east side of Larabanga. This takes one to within twelve miles of Konkori, where the scarp of that name continues the delimitation. On the north there are only the communal boundaries of the villages to divide Bole from Wa.

The language chiefly spoken is that of the Dagarti. These people held the country till a few hundreds of years ago, when they were conquered by the Gonjas, as was all the country from the Black Volta to the farther side of Togoland. Here, as in better-known history, the conquered have imposed their language on the conquerors, and the ruling chief of all the Gonjas is unable to speak his own language. In the south the land till quite recently belonged to Ashanti, and all the villages south and west of Bandankwanta, with those round Buipe as far north as Tolondo, speak the Mo dialect and Twi rather than Dagarti or Gonja. On the Volta in the north-west dwells a colony of Lobi people, who, though they have a good language of their own, can all speak Dagarti as well. Hausa is gaining ground as a universal language, especially amongst the children, who learn it at the Mallam's schools which are in every large village. Though the people are pagans there are a fair number of Muhammadans amongst them; they are very ignorant, and continue to believe in the fetish, but it is regarded as an advance, and they wear turbans and think it wrong to work for the government.

The paucity of the population is the great drawback to the development of the district. This came about in quite recent years through the advent of a man named Samori, and the ravages of influenza. Samori was a slave trader who came over from what is now the Ivory Coast and harassed the country, either selling the people into slavery or killing them, and driving off all the cattle. Many of course escaped and fled the country, some to return when the British ruled the country, others to remain abroad. The devastation of Samori was enhanced by an epidemic of influenza during the war, which decimated the already too thin population. Abundant evidence of this decrease is seen in the bush, where ruins are found in all parts. Some of the more important are marked on the map. The significance of this will not be understood till one starts to travel in the country: a native when directing one will always speak of a ruin as of an existing town; until one knows the country and the native, this is apt to lead to mistakes. I have several times planned to stay the night at a populous town and found it to be a ruin miles from any habitation.

* The Author's title was "The Bole District." A recent official map shows, however, that the District name is now Western Gonja.

The district is divided into four parts by two ancient roads, one the trade route from Kumasi to Wa and the north, the other from the west through Wandara and Bole to Larabanga and the east.

Two things are the same all over the district. The soil is light and sandy and contains a large proportion of iron which is apt, in conjunction with rain, to turn the soil into laterite. The sides of the hills are almost washed bare of earth, which is deposited in the valleys and forms very good farm land. Secondly, the country runs in waves, which, though not always in the same direction, are of the same height and distance from crest to crest, namely, 3 miles from crest to crest and from 100 to 200 feet high. These undulations make it impossible to see for any distance, as one's horizon is always the crest in front or the crest behind. The absolute lack of landmarks caused by this feature of the country makes it extremely difficult for the traveller to find his way, and even the native, when outside his village area, may not always find his way home by nightfall. It is made more difficult for the white man by the presence of numerous game paths, all of which are equally good as the track he is expecting to find, if not better. The troughs between these waves become swamps in the rains. This is really a blessing for the country, as the grass that grows in them remains green long after it has been burnt in other parts.

There are no mountains in the district; but between the village of Jama and the Volta there is a tract of country broken by short ranges of steep rocky hills, between which the paths to the small villages on the river wind their way. Even from their tops one sees only a mile or two of bush and not even the river, a bare 6 miles off. The hills are about 400 feet high, which is however higher than any other hill in the district. It is peculiar that, though these hills are so low, the steepness of their sides, the narrowness of the defiles through which one passes, and the bush make one feel as confined as if in a cañon of the Rocky Mountains. It is fortunate that there are no hostile natives in the district, as better country for an ambush could not be found.

Throughout the district one finds abrupt rocks rising almost sheer out of the bush to a height of 100 to 200 feet. These hills, about twenty in all, are named by the natives and are the dwelling-places of a fetish. The best specimen is that at Kabalima. One would expect these hills to serve as landmarks, but such is not the case, as the bush prevents one from seeing them till one is at their very base.

The area north of Bole and west of the road has no very striking physical features. The country to within a mile or two of the river is the usual undulating bush, broken here and there by hills and outcrops of grey stone covering from a few square chains to 2 or 3 acres. At the Lobi villages of Saru and Kaleba on the Volta there are extensive flats. As a rule these flats do not extend for more than a half-mile from the river, but here they widen to 3 miles. They are almost dead level,

and in places are quite open or only sparsely covered with acacia bush. In the wet season they are covered with water and a thick mat of bamboo grass, in which one sinks up to one's waist if one is foolish enough to try and walk across it. During the dry season, except on the very bank of the river, there is practically no grass, and the ground is hard and smooth enough to bicycle on. Game can be seen on these flats up to half a mile away, a contrast to the usual bush. This flat is typical of all the river flats, except for its greater width.

North of Larabanga and east of the road the country is of much more interest, for it contains a real river, a clear running stream, and a high precipitous scarp. This river, the Mori, and the Volta are the only perennial streams; out of all the rest there are only some half-dozen that have any water at all in the dry season. There is also the Muhammadan town of Larabanga. It is built on the edge of the scarp and one can see 30 miles to the north, an unusual range of vision. From here on a clear day one can see the cliffs and promontories of this scarp, which runs from end to end of the district, broken in two places by rivers and varying in height, but always easy to follow. Looking north at the scarp is very like looking west along the coast of Devon at Lyme Regis. The main breaks in the scarp are caused by the Kobongura where it flows into the Mori 8 miles north of Larabanga, and by the Mori itself, and by the Labani 7 miles south of Damongo. The breaks are not striking declivities or gorges, as the scarp falls in an easy gradient to a flat $1\frac{1}{2}$ miles in width, in the centre of which is the river. The flat north of Larabanga is much like the Volta flat already described. The grass is ordinary straight bush grass in place of the bamboo variety. The swampy land by the river swarms with an animal called Chemberi, which is much loved by the native as food. The ground east of the scarp slopes very gradually down for 10 miles or so till it returns to the general level west of it. There is in this area another scarp just south of Gungweli on the track to Bugei; it is much the same as the one already described, except that it is smaller in height and length and runs in a south-westerly direction. At the crossing of the Bugei track it is 150 feet high and nearly perpendicular, and runs thus for several miles on either side, a splendid line of defence in time of war. From Bugei to M'Bolebi is all broken country, and the usual smooth undulations do not start till 3 miles west of Jang, which is itself situated in a hollow surrounded by bare rocky hills, covered with enormous diorite boulders.

The southern portion of the scarp is of much less striking appearance, the side in most places sloping at a gradient of 1 in 8 to 1 in 4. The town of Damongo is built on the top of it and overlooks a considerable area of bush. From here it curves away eastward. In following the scarp from end to end one is apt to think that it varies greatly in height; this is a false impression, caused by the different degrees of slope leading up to it. At Larabanga one starts to ascend 3 miles off, and only the

last few hundred yards are at all steep, while at Konkori one climbs up with no little trouble.

Between Masakpe and Kelidu camps there are some old gold diggings, which the chiefs say were worked by white men before we took over the country. They also tell one that the white man paid the paramount chief and the chief of Bole five hundred pounds per annum for the privilege of digging their not very valuable soil There are in the district other workings, including several acres at Wasipe, which the Gold Coast Geological Survey have examined.

The largest extent of open country in the district is in the south-east, between Benyalipe and Morno, where flats like that already described sun the whole way with a width of 3 miles, only broken by the river Bobor and its fringe of palms. In the dry season the ground is hard and smooth, except for marks of hippo's feet, which, made at the end of the rains, bake hard in the clay soil and remain perfectly fresh till the next wet season.

With regard to the drainage system, the Volta flows from north to south on the west, the Mori in the same direction on the east side ; thus the general slope is from north to south. The rate at which the Volta flows indicates a fall of not less than 8 feet in a mile. One would expect from these two rivers to find a simple watershed from north to south somewhere in the centre of the district, but though generally speaking this is so, it is complicated by the presence of the Labani rising at Senyon and flowing from west to east almost from one side of the district to the other, and by the Jara, which rises near Gurupe and flows north-east. I strongly suspect that a river rises a little east of a line drawn from Gurupe to Jang and flows east into the Lunguru, and that the Jara falls into it. From this conjecture and the evidence of other rivers, it seems that the main watershed runs from north to south a few miles east of the big road from the north.

The Black Volta is the first river in importance, but is of remarkably little use. In the rains, which begin in July and last till October, it is a raging flood, from $\frac{1}{4}$ to $1\frac{1}{2}$ miles wide, flowing at a rate of 4 to 8 miles an hour ; this makes navigation impossible, or at any rate too slow to be of any use. In the dry season it is a mere series of pools and shallow rapids. The banks are in most places perpendicular ; if it were not for the landing-places of the hippos it would be almost impossible to disembark for miles on end. The sides are fringed with dense vegetation, tall trees, tangled creepers, and bamboo grass. From Fuchubluma north there are many timber-covered islands and rocks, the latter submerged at the highest level of the water in October. The actual bed of the river is usually 150 yards wide, and is of sand or rock. The next biggest river is the Mori (Mori is the Gonja word for a river). It is not as big as the Volta, but is otherwise much the same, except in the north where the banks are low and sandy and devoid of any luxuriant vegetation. There

are a few others that do not dry up altogether; they are the Yerada, Labani, and Yankama, the Jara and Lunguru, and the Kivan and Bongbo. The narrow strip of forest which fringes these rivers is a pleasant change to the eye, especially in the months of January and February, when elsewhere the trees are leafless and the grass burnt. There is, however, a greater treat for the traveller on the track from Kanyangbo to Konkori; a little stream clear as crystal bubbles merrily over its gravelly bed, with fan palms and flowering shrubs casting just enough shade to keep the water cool for drinking by the carriers. This is the river Wa Wa. As for the rest of the rivers marked on the map, they are quite waterless till well after the first rains, but are important to the traveller in that they are always spoken of as rivers in directions, and in the rains they can be very serious hindrances to progress.

It is worth noting here that only 4 per cent. of the natives can swim; crossing a river in the rains is therefore a tedious business, but most amusing to watch. One is careful to collect two or three men who can swim from the last village one passes, and these men each bring a gourd in the shape of a large basin. The non-swimmer holds it at each side and wades into the water; when it reaches his chest and the gourd is on the water, his feet float up, so that he is lying on his back with the gourd held down on to his chest. The swimmer then pushes him across. The boys stand on the bank shrieking with laughter and shouting ribald remarks, but when at last it comes to their turn, it is a very different matter. Those that can swim are very expert, and they perform wonders at diving for lost articles of equipment.

The general appearance of the bush varies but little all over the country; on the whole it is taller and thicker in the south than in the north, and is thinner and more stunted in the east. The seasons however cause a great change. In October the rain ceases and the grass which is 8 feet high begins to dry off; by the end of December it is all burnt. The fires thus caused shrivel the leaves of the trees, which fall off; the trunks are blackened and the ground is bare, the only green remaining being in the swamps and on the banks of the larger rivers. In April the tornado season commences, and the new grass begins to sprout and the trees and shrubs burst into leaf. The bush is now at its best till July, when the grass shoots up and hides everything from view. In January an animal is visible in the bush at 200 yards, in June it may not be seen at 50. In the south there are some small patches of rain forest of gigantic silk cotton trees and the usual tangle of creepers and Giginia palms in the more open spaces. These are notable at the Krubo river and at Malwe on the main road south, and at Munchape and Wubo on the track to Morno, and in many places on the Volta river. The average height of the bush is about 22 feet in the south and 18 feet in the north; there are from one to two hundred trees per acre, and between these, young trees and shrubs. Old town sites are easy to distinguish by the

superior tallness of the bush and the presence of baobab and cotton trees, and a particular kind of thorn bush. The baobab is never found elsewhere, and cotton very rarely. Owing to the annual fires straight poles for building are very hard to find. The Giginia is useful in that the trunk splits easily into rough scantling, and it is sufficiently strong, but it is not found everywhere, often has to be carried long distances, and is getting scarce. The natives tap it for wine, which kills it. For sawing into timber the best tree is Kawo, a sort of mahogany, in appearance like Australian red gum. The trunk of a good tree may measure 10 feet in girth and 20 feet long, but they are usually smaller. The timber sawn from it is of poor quality, hard and brittle, and during drying it is apt to twist and bend in all directions. Trees big enough to saw into boards are not easy to find. There is no mahogany or ebony in the district. Another tree that can be sawn is called Doka, though its qualities are worse than Kawo. All timber is liable to be eaten by termites except Giginia palm. There are a number of edible fruits, of which the Shea butter has of late attracted the attention of the commercial world. The tree averages 15 feet in height, but may grow much bigger; the fruit is like a green plum and is composed chiefly of a stone. It is from this stone that the shea butter is expressed. This enormous stone is a characteristic of all fruit in the country. The edible part lies in a thin layer over the stone, and is very sweet and creamy. I do not know of any process having been found by which the indiarubber-like constituent can be removed from the butter. This and the cost of transport have up till now prevented its being exported in any large quantities. The butter is a bad substitute for lard in cooking. If used continually it is apt to cause indigestion on account of the above-mentioned guttapercha. Very little is made in Bole, and the cost of it when imported from Wa is the same as that of lard in tins from England. The natives make soap out of it, but this costs as much as British soap and is very extravagant to use. The tree grows mostly in the north and is not seen south of Malwe. The Akee Apple is made by the natives into soup by boiling the fruit after the stone has fallen out. There is a wild cherry, yellow in colour and very sweet when ripe, but sour to the last degree if not. The native name for it is "sour." There is another that cannot be distinguished by appearance from an orange; its shell, however, is as hard as wood. When broken it is found to contain seeds of the same shape as those of an orange, covered with a yellow fibre, which when it is ripe is sweet and juicy. There is another resembling a pomegranate, and another resembling grapes, though the bunches hang from a tree and not from a vine. These are very good when stewed. There are some poisonous shrubs, the commonest of which is Samberu; a few leaves of it are fatal to sheep and goats, and the traders from the north passing through with flocks lose a good number from its effects. Flowering and sweet-scented shrubs grow everywhere, and the bush is often

redolent of them. Of flowers at the beginning of the rains there are a good number: lilies and orchids are most usually met with; whole acres of lilies, with long white petals having purple stripes down the centre, burst into flower during the night. There is also a large white one that grows in the swamps, and yet another, a small one, of which the stamens grow from the ends of the petals. There is a tall blue orchid that takes the place of our fox-glove, but the quaintest of all is a big bright red ball of stiff hairs, which grows to a diameter of 6 inches on a short thick stalk and has a bulb for root. The water-lily comes up later on and is much the same as the English plant.

There is plenty of game of all sizes, from hares to elephants. The usual game animals are Hares, Oribi, Duyker, Reed buck, Red-fronted Gazelle, Roan Hartebeeste, Wart hog, Bush pig, Buffalo, Water buck, Harness antelope, Hippopotamus, and Elephant. Less common are the small red Bush cow and Bongo. Lions are more often heard than seen, usually by postmen and messengers either when they are very late or have lost the letters or message. They sometimes eat letters, so they tell one! There are plenty of elephants, but the great majority do not carry big tusks. The best I have shot weighed 176 lbs. for the pair, and these are the biggest I have seen. Till quite lately there was nothing to prevent the native from killing all elephants, regardless of sex or age, so they only shot the small ones, as they say their guns will not kill the big ones. This has been their practice for many years past, and may account for the smallness of the ivory. Now it is a crime to kill an elephant with, or to be in possession of, a tusk that is under 20 lbs., so it can reasonably be expected that after some years the ivory will show an improvement. Shooting is different from East Africa on account of the thick bush, which makes it impossible to see the game till one is quite close to it. A stalk is very unusual. Very sharp eyes and much practice are required for this form of shooting. If one wishes to shoot a certain sort of game, one must walk through the bush till one picks up the fresh tracks and then follow as quickly as possible. All the larger animals move at a good 4 miles an hour even when feeding. Great care must be taken not to walk right into them without seeing them; the native hunter will always do this if he is allowed to walk in front. Elephant shooting is best in the height of the rains; then the tracks are easy to follow, and the sun may be hidden by clouds all day: this is a great consideration, when one may have to follow for five hours at a pace between a run and a walk before one comes up with them. In the dry season the tracks are hard to see, and one may go all day and never catch them. Of other animals there are all kinds, cats and ferrets, and Chemberi and monkeys galore; dog-faced baboons and organ grinders' monkeys come to spoil the farms at night. In the tall timber there are little grey ones, and in the dead trees on the banks of the Volta sit black ones with long white tails which hang like ropes gently swaying in the

breeze. There is a small trade done in these skins; traders from Kumasi come round collecting them. They are worth about five shillings each. The Chemberi is an animal of the appearance of a beaver with a long tail, but its hair is coarse and is almost a quill; it lives in the swamps and eats grass and is hunted at the end of the rains by the natives for food. The procedure is for two or three villages to meet at a swamp armed with clubs and spears and sticks, the swamp is surrounded, and the grass set alight. One or two will break away at the sides, but the majority will stick to the last bit of cover till it commences to burn, when they break away as fast as their little legs will carry them, with half a dozen wild men after each, hurling clubs and spears and whacking with sticks. The bag is collected and laid out, and the headmen divide it amongst the villages participating.

There are reptiles of all kinds, but they are not often seen and give very little trouble. Snakes are kept down by the annual fires. Game birds are practically confined to bush fowl and guinea fowl. On the Volta in the south one occasionally sees a duck. I have not seen more than a dozen and only one snipe. Pigeons even are scarce. I was forgetting the little francolin, known to the native as the "cock of the rocks"; this bird is the best of all to eat if only one can get enough to make a dish. One can always hear him but rarely see him, the reason being that, as soon as he hears any one approaching, he hides in a hole in the rock, from which retreat he continues to whistle merrily. Non-game birds are too numerous to describe; suffice it to say that there is every sort imaginable. Besides all these there are some migratory ones which arrive with great regularity from the north at the end of the rains. These are the small white egret, large and small bustard, and sand-grouse. The egret arrives at the end of October, the sand-grouse in the middle of November, and the bustards later on in January.

The climate is equable and one experiences no extremes of heat or cold. March and April are the most unpleasant months; this is the tornado season, so called because of the storms which occur every four or five days. They are not really tornados at all, but the wind makes up in noise for what it has not in velocity, because of the bush over which it travels: the rain accompanying it is heavy, and an inch may fall in twenty minutes. The heat for a day or two before these storms is most oppressive, and is of the prickly heat sort. In January the Harmattan wind blows. It is not felt as much as it is 150 miles further north, but the mornings from an hour before sunrise till half an hour after may have quite a frosty tingle. August and September are pleasant; the sun is often obscured for a day or two on end. Most of the rain falls at night. In ordinary times when travelling, one has to start in the dark so as to be in by nine or at latest ten o'clock. Later than this the sun becomes too hot for the carriers and most unpleasant for oneself. But during these months one can start comfortably at eight and travel till midday.

The average temperatures for the year are :

Maximum	*Minimum*	*Wet bulb*	*Humidity*	*Rain*
91	70	75	45 per cent.	42·4

which gives an all-round temperature night and day of 80·5.

I will now deal with the people and their houses. The district contains Mos in the south, Lobis in the north-west, Tamplumas in the north-east at Konkori, Sala, and Gungweli, and Dagartis and Gonjas mixed in all other parts. There is one large village, Bandankwanta, of which the inhabitants are nearly all strangers. There is in all towns a small section of Hausa people ; they are usually traders who have settled in the country and carry on cattle-buying and butchering. Along the river are small villages built by fishermen from Ashanti and the coast. These as a rule consist of only one or two huts. In January they start fishing, and can be found camped on all the islands in the river. They catch fish with cast nets, selling a little locally and drying the rest to sell elsewhere. The native is not a fisherman, and only occasionally builds dams across the smaller streams, with a view to stopping the fish from escaping downstream as the water dries up.

The villages south of Malwe are built of a framework of poles filled with mud and roofed with thatch. Each family usually has three huts built on three sides of a square, with the enclosed space beaten hard. All cooking is done outside on this floor. The villages north of this are built of mud ; the walls are built tier by tier, each tier a foot high. Two tiers may be done at once and left for a day to dry, and so on till a height of 6 feet is reached, when poles are laid across the top, which are covered with mud and then beaten, when this is dry another tier is put on round the top, thus forming a low wall all round. The doorway is cut out after the room is completed. Each hut is about 8 by 10 feet. The next man comes and builds his, using a wall of the first man's as a wall of his, and the next joins on to his, and so on, the whole village making a regular rabbit warren. The usual way to enter a house is over the roof. Logs cut out in steps are leant up against the outside walls by which one climbs up ; there is another by which one descends into the yard. By walking on the roofs one can go round the whole village. This plan of village has many drawbacks from a sanitary point of view : the drains of one house run into the next, besides which the interiors of the rooms are almost dark. In the dry season the people live largely on the roofs. The Lobis have the same sort of house, but each man has a separate compound, often a long distance away from each other. The village water supply is a dreadful thing, consisting of a series of shallow holes in the nearest swamp, or at best in the bed of a dried-up river. It is sometimes too bad for a white man even to wash in.

The native's occupation, if he can be said to have one, is farming. Each man has his own farm, where he grows maize, millet, dawa and yams, and perhaps a few ground nuts, marrows, and sweet potatoes, and possibly some beans. He never succeeds in growing enough to last all the year round till the next harvest. The shortage of food in March and April is always a trouble. Each man has a few goats and a miserable-looking sheep or two. Guinea fowls and poultry are kept in a more wild state, and sometimes pigeons. There are very few cattle, as the herds have never been brought up to strength since the incursions of Samori. Those that there are seem to do well enough, but the country could never carry many head owing to the scarcity of food in the dry season and the lack of water. The natives do not milk their cows; it is most trying for a new-comer to arrive at a place and see cows in milk and be told that he cannot have any because they do not know how to milk them. Each village has its hunter, who always seems to have less idea of hunting than any one else. It is surprising that they ever shoot anything at all, so great is their lack of skill. When one knows that there are over 1600 men with guns out of a population of 10,000 all told, it is a good thing for the game that they are not more skilful. No reliance whatever can be placed on anything the hunter says about the game in the locality; if there is plenty he will say he has seen none for the last two years. The reason for this is that if he says there is game and one does not see any, he is afraid that one will be angry with him for telling lies. When he gets to know one, the opposite is the case, and he has stories ready for one of elephants on the farms only a few hundreds of yards off. In other cases it is genuine ignorance. The hunters are bad trackers, and often have poor eyesight. They have a most annoying habit of waving their arms when they see anything, and very often when one has been watching game for some time for a shot they will suddenly see it and rush in front of one, pointing and waving, thereby frightening the game away.

During the dry season, on the main road from the north there is an almost continual stream of traders going to Kumasi with cattle and sheep and donkeys loaded with shea butter and dried fish; they return again with kola nuts and European goods, which they retail at all the towns on the way up. These are a source of income to the villagers, who sell them food at the most exorbitant prices. This I think may be the reason for the shortage of food.

The only artisans are the mat-makers, who produce a very good coloured grass mat, plaited in most artistic colours and patterns; they cost from ten to twelve shillings each. A small amount of weaving is done on the usual primitive loom, which weaves strips of cloth four inches wide.

GEOGRAPHICAL NAMES IN THE ZANDE COUNTRY

Capt. J. E. T. Philipps, M.C.

THE area occupied by the Zande Confederation, estimated at between three and four million souls,* extends roughly from the Nile (the Makaraka-Azande of Rejaf-Yei District) to the main Congo river towards Bumba and over the south-west of the Ubangi-Shari colony of French Equatorial Africa. Zande names are easily distinguishable on a map.

It has not been the custom of the Zande people to live in villages or to form agglomerations of populations.† The Zande migratory conqueror has not yet felt himself anchored to the soil. Each man prefers to live isolated with his family in the bush, where he has his own preserves for hunting, fishing, honey, ant-hills,‡ and mushroom-beds. He may change the site of his home as often as a favourite dog dies or a peripatetic divinator advises that the place is unhealthy. In the course of journeys in 1921, 1924, and 1925 among the French, Belgian, and Sudan Azande respectively, I was frequently brought up against the difficulty of nomenclature for precise geographical location. When, for instance while shooting, it happens to be necessary to arrange a bush rendezvous for one's tent or stores, one is often faced with a complete lack of villages and place-names in general for one's directives. Azande, speaking among themselves and proposing to visit any particular place in the bush, will refer to it by the name of the nearest person who has the usufruct of the immediate locality, merely specifying what they want to go there to do or find; *e.g.* K'ani ndu ku Rikita—Yo ka de Angwa: "Let's go to Rikita's—there to cut poles." In point of accuracy, the destination may be as much as 2 or 3 miles from Rikita's house and cultivation.

There has been no natural grouping of population, and no villages, therefore no names of villages.

The *gbwanga* court(yard) or headquarters of a territorial chief, where there may be as many as 100 wives and another 100 armed followers, has equally no place-name. A Zande, going to his chief for a "palaver" or to take his tribute, simply describes the place to which he is bound as: Mi nandu ku Gbwanga-Yo. "I am going to court." For there is only one to which he recognizes allegiance. Similarly, if he is going to see a friend, every one is presumed to know where he lives and no

* Père van den Plas, the historian of the Azande, in a public lecture in Cairo in January 1918, as reported in *L'Egypte contemporaine.*

† 'Travaux de l'Institut de Sociologie.' Monograph by A. de Calonne-Beaufaict. 1921. P. xxii.: "Le Zande a l'horreur des agglomèrations. Chacun vit isolé avec sa famille."

‡ The viscous earth of some ant-hills is prized for building, and flying white ants are pressed for oil and eaten in their season.

place-name is used Exceptionally a few outstanding hills may be dignified by names derived from some remarkable peculiarity; such are *Ba-Ngenze*, "father (of) snails," and the haunted *Zaba* hill near Bafuka's. Government rest-houses have been habitually called by the name of the rest-house keeper or of the nearest petty chief. If the rest-house keeper is transferred or dismissed, the people naturally cease to talk about the absent as if he were there. If the chief dies, the raw native, especially relatives, will often prefer not to mention the name of the deceased, for "is not his name as much a part of him as his soul or his eyes?" One has seen some rest-houses, the few fixed points in the country, change name as much as three times in a year. At present a considerable proportion of place-names on maps of this considerable area of Africa, of which communications and commercial developments are now so rapidly advancing, are those of small Azande chiefs, many of whom are already dead and some forgotten, and the places themselves already often uninhabited and abandoned.

A few chiefs whose courts (*gbwanga*) became also the site of a government post, have thus after their decease had their names perpetuated into permanent place-names. Some of such are Obo, Zemio, Wango, Mopei, and others westward and along the Mbomu-Ubangi in the French territory; Tambura, Mopoï, Yambio in the Sudan; Dungu, Niangara (Yangara's), Doruma (Ndorumo's), Bambili, etc. in the Belgian Congo. But, in general, place-names in this part of Africa are lacking in permanence and are in a constantly recurring state of fluctuation and change. On revisiting in 1925 an important centre of Zande life where I had not been since 1921, I found that the same chief had twice changed his name, and thus that of the locality, since that time. It is almost as confusing as a post-war journey in Slovakia or Transylvania. In the Zande country rivers happily have permanent names, though there is frequent confusion by their limited variety.

But there is a new and unexpected factor which has arisen in the past year. In all three territories motor roads are being pushed into the interior from the great river arteries—the Ubangi, the Congo, and the Nile. In order to facilitate medical inspections for sleeping-sickness, the people are being settled along the main road, which is radically changing their mode of life and creating, for the first time, extensive village settlements. Roads, where possible, pass above the heads of streams, and villages are seldom parallel to rivers. It will be interesting to see whether a people who have in their language no name to signify a town or a village, will begin to feel a need for such a term in their vocabulary. When I left the neighbourhood a few months ago the people were still referring to a village solely by the name of its chief. For example: Bami Nala ko yo du Mopoï ni, "My father lives there where Mopoï is."

But to aid in stabilizing village rest-houses as fixed points with fixed names, each rest-house in the Tambura area is now referred to by

Government in relations with natives by the name of the nearest stream from which the water for the rest-house and village is obtained. It is far from satisfactory, but is at least a step in the right direction.

I endeavoured while in Tambura to interest my French and Belgian colleagues who were also administering Zande country, towards the compilation of some common record of Zande geographical names which might thenceforward be standardized and maintained. They admitted experiencing the same difficulties on their side, and one hopes that something useful may materialize from their initiative. Of the three systems —American, French and Belgian—of rendering Zande names the Belgian is to my mind the most accurate.

Meanwhile it may perhaps be possible for the respective geographical societies to explore in friendly collaboration the possibilities of stabilizing and standardization in the three zones of the Zande country.

RECENT EXPLORATIONS IN THE NORTH-WEST DISTRICT OF PAPUA

Leo Austen, Assistant Resident Magistrate

NOW that I have explored some 2000 and more square miles of that heretofore unknown country of North-West Papua which lies between the Palmer River and the Dutch boundary (141° E. long.), perhaps a short paper on the salient features of this area may not be out of place.

In the *Geographical Journal* for November 1923 appears an article of mine on the Tedi River District which dealt mostly with the anthropological side of my expeditions, but since that was written I have made a third expedition to the north-west, and covered much new ground eastward of my previous work. On this last expedition I left Daru on 31 August 1924, accompanied by Patrol Officer Thompson, ten armed native constables, and thirty-three carriers. Our voyage up the Fly River as far as Macrossan Island (425 miles) was more or less uneventful, through low flat and swampy land, with here and there a 30 to 50-foot red clay hill to relieve the monotony. Before reaching Macrossan Island, however, and between it and D'Albertis Junction (460 miles), this kind of country gave way to soft sandstone hills of probable late Tertiary origin. These were never higher than 100 feet.

From Macrossan Island the expedition travelled overland, at first westward and then northward to the Fly River a few miles above Palmer Junction. Part of the country here consisted of densely wooded sandstone hills up to 300 feet in height—the sandstone in some places being of a blue-grey grit, whilst in others it consisted of purer sandstone, but also apparently unfossiliferous.

The crossing of Fly River was accomplished with great difficulty, owing to rapids near by. On the northern bank a base store was erected, where food for the return journey and all dispensable articles were cached. The store was protected from the raids of local natives by placing home-made sorcerer's charms on each side of the house.

From the Base Camp we proceeded northward over precipitous sandstone hills 150 to 200 feet in height, and all covered with dense forest, until we neared the Tully River (Wai Miu), when we came to outcrops of limestones dipping at 28° to the south-west. All the outcrops of sand and mudstones seen previously had dipped at an angle of 5° to 10° to the south-south-west. This outcrop of limestones will probably be proved to be part of the same rock which strikes the Palmer River above the Tully River Junction at a place marked on Macgregor's 1890 map as "Limestone Rocks." The former limestones are lost at the Wai Miu river, for after crossing it we did not meet them again for some days.

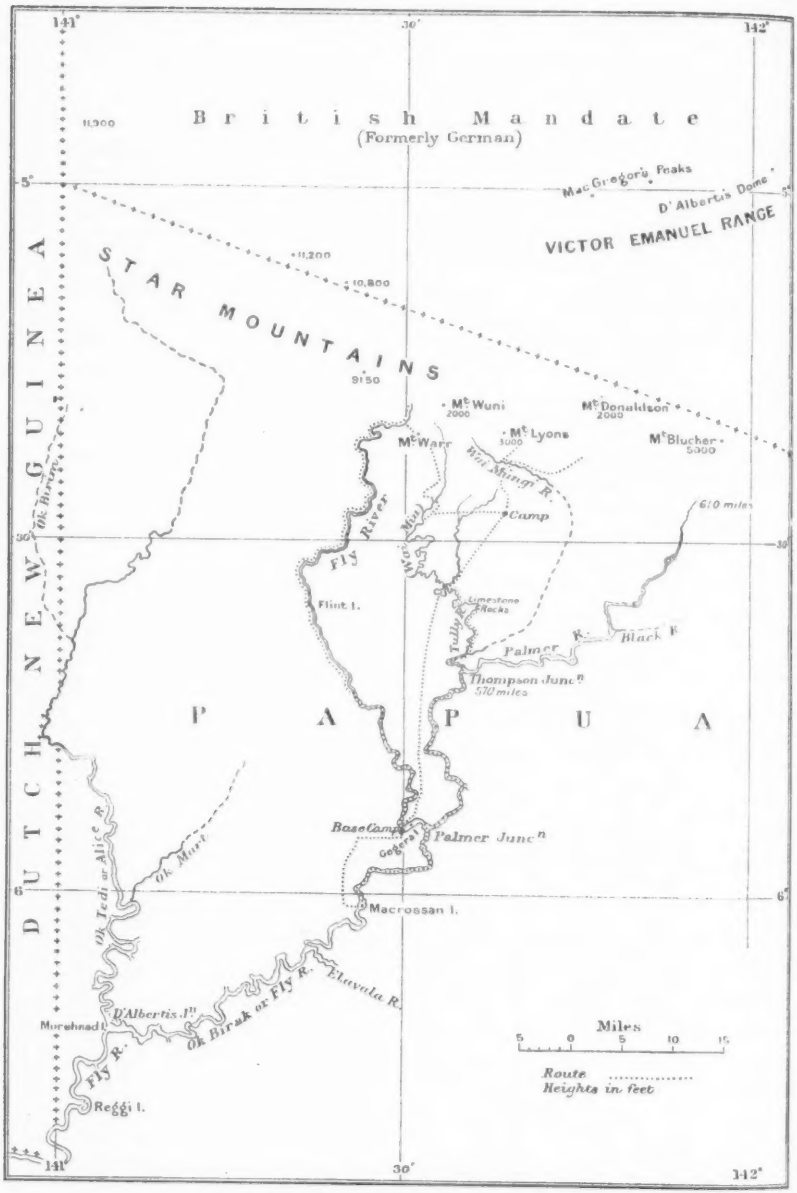
North of the Wai Miu the country consisted of forest-covered sandstone and mudstone hills, if anything even more precipitous than those south of this river.

The discharge of the Tully river where we crossed was at the time 287,000,000 gallons daily. This would be considerably increased during the "wet" season.

The sandy mudstones north of the Wai Miu showed narrow bands of lignite, of probable Tertiary Age, between the various deposits. No fossil shells were noticed in these rocks, though perhaps when my collection has been classified, fossils may be found.

On 15 October we formed a second cache on a spur leading north-east and at 450 feet above sea-level. Mountains 2000 to 3000 feet were now close at hand and separated from us by only a few ridges.

At the next camp a site was chosen some 500 feet above sea-level, and near by on a ridge top (750 feet) I discovered a cliff of what I took to be calcareous tufa, 400 feet in depth, showing one mass of fossiliferous mudstones with calcareous bands. These rocks dipped 10° to the S.S.W., and the north side of the ridge was precipitous to an extreme. At the bottom small streams ran underground, though further on in the valley (the Wai Mungi valley) the water of other streams flowed over the top of the rocks. Several hundred yards from the last camp our road led through huge boulders of what I thought was travertine, but which on microscopical examination proved to be limestone. To quote from my diary: "Although these boulders lay over the ground in every direction there was a certain regularity and order about them that made me believe that an upheaval had taken place after the "travertine" had been formed, and not before. Leaving these rocks behind, we again came to sandy mudstones which dipped 12° S.S.W. The country then became low and flat, and we crossed a creek called the Wai Waworo, which flows into the Wai Mungi, a tributary of the Tully." In this



SKETCH-MAP OF NORTH-WEST PAPUA.

creek on the return journey I found outcrops of limestones and sandstones, but the former outcropped only a few feet in width, and its dip was indistinguishable.

North of the Wai Waworo we camped at 450 feet. Some miles to the west of this camp I afterwards found that outcrops of limestone again made an appearance and continued north-west into the mountains. This limestone was terribly broken, and will be described fully later on.

The descent to the river below (the Wai Mungi), which is the main tributary of the Wai Miu, was attended with great difficulties, owing to the nature of the country. It was observed that the dip of the sandstones was now changing, at first 20° to the south and then at the same angle to the S.S.E. All the sand and mudstones were now fossiliferous.

After crossing the Wai Mungi the ascent of the mountains began. To quote again from my diary: "At 450 feet above sea-level and 250 feet above the bed of the Wai Mungi, I found the sandstones had petered out, and limestone outcropped. As soon as I noticed that the whole spur was composed of this stone I sent word back to Mr. Thompson to have the rice washed and the saucepans filled with water for the midday meal. Proceeding upwards, at 600 feet I remarked a change in the nature of the limestone. The former had been of so close a texture that it was difficult to detect fossils with the naked eye, but in the latter there was no doubt about its being fossiliferous. Near where the lower limestone outcropped I noted its original overlying beds of sandstone in which were innumerable fossil salt-water shells and coral. Most of this sandstone layer had been washed away by weathering, though here and there it appeared in small patches 8 or 9 inches in depth, while all around were strewn the fossil shells and coral that had resisted the ages of exposure to the weather. Then the limestone became more and more broken, and as I progressed the fissures became more numerous until eventually it was impossible to advance over this impassable barrier."

As it is not intended in this paper to deal with the personal side of this expedition, I shall not go into the details of the hardships and difficulties one and all experienced in the mountains, but where I may seem to do so it is merely to stress some geological point. Water was unobtainable as soon as we had reached a height of 600 or more feet above sea-level, though in one or two places we were fortunate in obtaining water by inadvertently breaking a rock, past which water was flowing underground. Of course, as soon as we attempted to find water ourselves by breaking off parts of the rock, we were never successful. During our journey among the eastern part of these limestone ranges, we sometimes found ourselves brought to a full stop by a huge chasm caused by landslip. The country on these ranges was densely wooded, but bird-life was scarce, and the fauna had totally disappeared as soon as the broken linestone was reached. My diary says: "The country on to the spur-top (2025 feet) was of the same terrible broken limestone. If

one could imagine some immense coral island suddenly thrown up several hundred feet above sea-level, it would probably bring forcibly to mind the type of country through which we were now working. Such an upheaval might mean that the coral would become frightfully shattered and large fissures would appear. This was exactly what seemed to have happened in this district. The lines of the fissures ran south-west to north-east, and standing in these cracks I could see that the dip was about 15° to the south-west. The clefts running along the strike were not regular. Though the limestones were covered with dense forest, very little soil was to be seen, and the roots of the trees clung to the rocks and among the decomposed leaves. Weathering had caused the rocks to become very jagged, with sharp, razor-like edges jutting out. One carrier to-day received a nasty wound in the leg owing to a fall through some roots which covered a crevice underneath."

From a camp in these mountains some 950 feet above sea-level, a wonderful view of the country from the south-east to the south-west was obtained. "As far as the eye could see, the country appeared to be one vast plain with a small hummock here and there. One would never dream the panorama was disclosing ridge upon ridge of precipitous sandstone hills among which one morning we ascended and descended over 28 times."

Another day I managed to reach a height of 1875 feet, but was forced to turn back. I then separated from Mr. Thompson and tried to get out of this awful limestone country lightly equipped, but was again forced to return owing to lack of water. I did manage to reach the height of 2025 feet—the top of one range—only to find a higher limestone range in front, while in the valley below the water roared underground.

The whole party then returned to the Wai Mungi, and searched the country to the westward, but found unscalable sandstone cliffs barring any progress at all, and as soon as we met the limestone the rivers ran underground.

I now arranged to return to the second "cache camp," and go to the west from there and meet the Upper Fly. On the way back to this camp I proved what I had merely observed on the forward journey, viz. that just to the north of this cache camp the volcanic gravels which were intermixed with the soil of the country to the south of this point petered out, and no more were to be found northward of it. These volcanic gravels were also found in great quantities in the soil of the Tedi River country.

On October 29 I discovered a river 30 yards wide, 3 to 4 feet deep, and flowing slowly. This was the upper Tully (here called the Wai Mur). At this camp I again separated from Mr. Thompson, instructing him to proceed down the Tully by raft and make a traverse of it, observing at the same time the points where the limestone outcropped, and obtain specimens for my collection. The country between the Tully and the

cache camp consisted of ridgy sandstone hills densely wooded, with steep slopes and never more than 300 feet above sea-level.

When we divided the party I took with me only five armed constables and seven native carriers—the very strongest of them all—for I knew that if I wanted to reach the Fly it would have to be done in forced marches, and many of the carriers were beginning to break up owing to lack of fresh vegetable food. I therefore took the best and continued overland north-westward.

Mr. Thompson traversed the Tully as far as the Palmer River, after much arduous work, and then continued on down the latter stream as far as the Palmer Junction, where I eventually joined him. In recognition of Mr. Thompson's splendid cooperation in the work of this expedition, and the fine traverse he made of the lower Tully River, I propose to call Thompson Junction—this river's junction with the Palmer.*

A few miles to the N.N.E. of the Wai Mur camp is one of the highest peaks of the mountain range which lies between Mount Blucher and the eastern end of the Star Mountains. I propose to call this peak Mount Lyons, in compliment to a resident magistrate of the Western Division who for many years administered this district, and who has done much exploration in the southern part of this division. To the west of Mount Lyons and forming part of the same range is another peak about 2500 feet—called by the natives Wuni, while a mile or two south is a much lower one, called by the local people Warr. Between these two latter peaks the Wai Mur or upper Tully River takes its rise.

With reference to this mountain range I have mentioned above, I am doubtful whether we should call the whole range the Donaldson Range, or whether it would be better to keep this name solely for that part sketched by Macgregor in 1890 and called by him Mount Donaldson. In the mean time I have left the name of this range on my map blank.

Behind this range can be seen the part of the Victor Emanuel Range mapped by Macgregor. This range, as shown by Macgregor, consists of two mountains, one the eastern, a great dome-shaped peak some 10,000 feet in height, while the western is separated from the dome by a wide divide. The western mountain has two peaks, the eastern being the higher. If these peaks have not already been named, I wish to suggest the name D'Albertis Dome, in honour of the naturalist who first discovered the Victor Emanuel Range in 1876. The western mountain with its two peaks I think might be called "Macgregor's Peaks," after Sir William Macgregor, who first sketched these mountains in their correct position in 1890.

I did not follow along Mount Wuni, but kept to Mount Warr. Both these mountains are composed of the broken limestone, but the latter was the easier to negotiate. From Mount Warr I descended to the

* The new geographical names suggested by the author, and included in the sketch-map, are necessarily provisional.—Ed. *G.J.*

Upper Fly River, reaching it at a point about 605 miles above its mouth. Here this river was about 100 yards in width and about a fathom deep. Limestone rocks were visible about 50 yards to the north, and around them the water swirled and foamed. The Fly River here is about 300 feet above sea-level, and it is just near where I met it that it begins to break up among the Star Mountains, among which it has its source.

It was now necessary for me to decide whether to continue on to the north or return down the Fly. It was very possible that I might not be able to return by the way I had come should I proceed further north over the limestone; my carriers were breaking up with the hardships they had experienced, and now needed a rest to recuperate. So I decided on mapping the Fly River. I therefore had strong rafts constructed, and voyaged down the Fly. Our trip was most eventful and fraught with many dangers in the rapids and whirlpools among the sandstone hills. Fortunately our food and gear had been packed in waterproof bags and strapped on with strong rattan ropes; we therefore lost none of our stuff when the rafts were thrown up on rocks or buried in the swirling waters of the rapids.

Near the 605-mile camp I inspected the shingle banks in the stream, and found that practically the whole of the banks were composed of limestone shingles with a very small percentage of apparently effusive rocks. But the latter were so few that it took a good search to find even the few specimens I obtained. No other volcanic shingle or gravel was to be found. A few miles north of Flint Island the older volcanic gravels began to appear among the shingle.

South of the Upper Fly, from where I met it, are many small islands which I have named after several officers who have done pioneer work in the exploration of the Western Division of Papua, while a few miles west of Palmer Junction I have called a small island Gegera Island, after my native Sergeant of the Police. Where I crossed the Wai Miu it was only 65 feet above the level of Macrossan Island, whilst the Fly River at this island is only about 30 feet above sea-level.

It appears to me to be very reasonable to assume that the country between the Palmer and the Upper Fly is an immense saucer-shaped depression which is drained by the Tully River and its innumerable small tributaries. The Fly River runs through the country forming the western rim of the saucer, and therefore has no tributaries other than very small creeks. The country as one goes westward gradually rises above sea-level. West of the Fly there must be another depression which is drained by the Ok Mart River, and the Tedi (Alice) River forms the western rim of this. Like the Fly, the Tedi River has few important tributaries; as a matter of fact, after leaving the Mart, there is only one tributary worth a name—the Ok Birim River, which rises in the western part of the Star Mountains, probably just over the Dutch border.

The whole of my geological collection has been presented to the Sydney University, and Professor Sir T. W. Edgeworth David has kindly interested himself in it. He will in due course be able to map out geologically the whole of the district covered by my last expedition. In the mean time I am unable to state the various ages of the sandstones and limestones passed over.* I feel certain, however, that the north-west district offers no field to the investor for any commercial proposition. The population is small, and the soil is poor. Gold can be found in the alluvial gravels, but in nothing like payable quantities. Brown coals and lignites are found to be covering a large area, but the seams are narrow, the thickest being only 2 feet. Even supposing the sandstones turn out to belong to the Tertiary Oil Series similar to those in the Vailala District of Papua, I am of opinion it would be waste of money for any company to prospect for oil in the north-west district, for the distance from the coast is very great. I have never found an oil seepage, though always on the look-out for them; and it would be very expensive to drill through the limestone.

MEDIÆVAL GEOGRAPHY

The Geographical Lore of the Time of the Crusades: A Study in the History of Medieval Science and Tradition in Western Europe.—John Kirtland Wright. American Geographical Society. Research Series No. 15. W. L. G. Joerg, Editor. New York: 1925. 8 × 5, pp. xxii. + 564. $5.00

THERE is no difference of opinion as to the extent of geographical knowledge in ancient times. It is sufficient to mention the names of Pythagoras, Crates of Mallos, Aristotle, Eratosthenes, Hipparchus, and above all Claudius Ptolemy. The text-books, however, fail to make it clear what became of the learning of the Ancients when, at the overthrow of the Roman Empire, civilization gave way to barbarism and culture was displaced by savagery. Could such a conception as that of the sphericity of the Earth, once established, be forgotten?

The question may be answered in one of two ways, according to the aspect from which it is viewed.

If by "the world" we are thinking of Western Europe, then it is to be feared that the question must receive an affirmative reply. When the Roman Empire, or, more strictly speaking, the West Roman Empire, was overthrown in 476 A.D., culture and learning west of the Vistula perished except within the narrow confines of the Christian Church. The work of the Church during succeeding ages was to teach the heathen and convert the barbarian. And this could be done without resort to geographical speculations or scientific research. Yet even when we admit this as being reasonable, and fortify our belief by a scrutiny of monkish attempts to make maps of the world, we should do well to admit one reservation. The Christian missionaries could not have prevailed over

* The specimens have now been determined by Professors Cotton, Brown, and Mr. W. S. Dunn, of the University of Sydney and the Department of Mines. A list of the determinations is deposited in the Library R.G.S. for reference.

the savages of Western Europe without the help of monastic fortresses on sea-girt isle or inaccessible mountain crags; and in the monasteries were preserved some of the ancient books from which science could still be gleaned. Thus, to take a single example, it is well known that Bede (d. 735) had a copy of Pliny's 'De natura Rerum,' and accepted without question the sphericity of the Earth. Still, in the main it is true to say that the books copied by Western monks were not scientific, and that, in the six centuries succeeding the fall of Rome, Western Europe ceased to profit by the wisdom of Aristotle and Ptolemy, and did not know Eratosthenes even by name. During this period geographical conceptions in Western Europe were as hazy and fantastic as among the backward tribes of Africa at the present day.

But though the world may be correct in attributing the present state of our knowledge, humane and scientific, to the nations of Western Europe, there is no adequate reason for seeking the foundations of that knowledge in the region where the richest harvests have since been garnered. In ancient times, certainly in pre-Christian days, Western Europe contributed little in the way of culture. It was out of the East that learning came; and if at that convulsion, which we call the Fall of Rome, we direct our gaze not to Western Europe but to Eastern, we shall find a different answer to the question already put.

The Byzantine Empire, which survived the Fall of Rome, comprised the best part of the Hellenistic world: Greece, Macedon, Syria, Palestine, and Egypt. Even in the greatest days of Rome the glory of the Empire was still focused at Athens and Alexandria, and these survived in the Byzantine world to vie with Constantinople for supremacy. The Byzantine Empire for a while endeavoured to redeem the West, but the crusade was abandoned when the menace of Islam threatened to number Byzantium itself among the empires of the past. In their struggle with the Moslem the Greek Emperors lost Egypt and the Holy Land irrevocably; they retained Syria for a while, then lost it, recaptured it, and lost it again. Syria, in short, was for centuries the battleground where Cross and Crescent met; Syria was the University in which the followers of Muhammad, either from Greek books or from Syriac, inherited the teaching of Aristotle and Ptolemy. Haroun-al-Raschid, the great Caliph of Bagdad, ordered his vizier Yahyâ to translate Ptolemy's Μεγάλη Σύνταξις; and thus early in the ninth century came the foundation of modern Science, the "Kitab-al-Majisti" which to-day we call the Almagest.

From Persia, which they also conquered, the Moslems perhaps acquired their love of the horoscope; and as Muhammad had ordained that all mosques must be orientated towards Mecca, the sciences of astronomy and applied mathematics went forward with urgent strides. Astrolabes of exquisite accuracy were being made by Ahmad and Mahmud, the sons of Ibrahim, at Isfahan in 980 A.D.; and nearly two hundred years earlier Al-Khwarizmi had completed his Kitab Surat al-ard (the Book of the Description of the Earth), which for brevity's sake might be epitomized as "Tables of Latitude."

Hand-in-hand with the progress of science went the Moslem military conquests, which carried their banners westward to the Strait of Gibraltar, across the Pyrenees, and to the banks of the Loire. Here in the eighth century they were checked, and falling back into Spain contented themselves with an advanced front roughly approximating to the Douro and the Ebro. Christian States remained alive in the mountains of Asturias; and, more particularly after the union of Leon and Castille, challenged the Moslem occupants of Spain upon their own ground.

The supreme importance of this was neither strategic nor yet national.

The scientific hub of the Moslem world had shifted from Baghdad and Isfahan to Cordova and Toledo. At a time when a monastic library of Western Europe would be fortunate if it contained three hundred books, Al-Hakem, the despot of Cordova, was credited with the possession of six hundred thousand. In 1080 Az-Zarqali, whose improved Astrolabe had put all others out of date, produced his "Toledo Tables," which were to prove for centuries a standard work. This compendium, which it must be remembered was prepared for the use of astrologers, would doubtless have reached a still higher degree of accuracy if it had been designed to meet the more exacting requirements of oceanic navigation. Five years later Ferdinand of Castile captured Toledo, and in doing so brought about a situation analogous to that when the Byzantine knights and the Muhammadan emirs fraternized on the battlefields of Syria. Only this time it was the Moslem who gave, and the Christian who received. Toledo became a lodestone that drew with irresistible force all the scholars of Western Europe; and in almost the same hour the preaching of Peter the Hermit enrolled legions of enthusiastic warriors to ransom the Holy Sepulchre at Jerusalem. The epoch of the Crusades had begun.

The pomp and glitter of the cross-clad knights has concentrated attention on the eastern theatre of the war to the exclusion of the western front along the Tagus. If there was luxury to be learnt in the cities of the Levant, there was wisdom and science in the cities of Spain; and it is here that we must look for the permanent results of an era too often dismissed as barren. By 1100 quick-witted French scholars were recrossing the Pyrenees primed with the scientific knowledge of their Muhammadan teachers, and with the works of Aristotle in Arabic and sufficient acquaintance with that language to translate it into Latin. Englishmen and Italians were doing the same. About 1140 Western Europe had three universities: Paris, Bologna, and Oxford; and Aristotle was again enthroned. The day of the great schoolmen had come: Peter Abelard, Hugh of St. Victor, Peter Lombard, William of Conches, Bernard Sylvester, and Alexander Neckam. In 1175 Gerard of Cremona translated the Almagest. Early in the next century John Holywood, the Englishman, better known by his pseudonym of Sacrobosco, crystallized the teaching of the Moslem world in his amazing work 'De Sphæra.' Meanwhile universities multiplied, and in the thirteenth century early European science reached its flower with the great names of Roger Bacon, and Robert Grosseteste, the saintly and encyclopædist Bishop of Lincoln.

Further than this the present inquiry does not extend, but it may serve a useful purpose to state at this point that the Renaissance, in the accepted use of that hackneyed word—the Renaissance which began with Dante, which was fostered by the loving care of Petrarch, and which in the mid-fifteenth century took the world in its embrace, was not (as it is so often called) the re-birth of "Learning," but rather the revolt of the Humanists against scholasticism; the insistence of Art and Literature that they were at least as worthy of man's regard as Aristotelianism, that is to say, Natural Science fettered by the dogmas of the Church and the subtleties of Logic and Philosophy. The point is a vital one, for it is not to the fall of Constantinople in 1453 that we must look for the beginnings of modern Geography, but to the earlier or Scientific Renaissance which synchronizes as already shown with the epoch of the Crusades.

What, then, was the state of geographical knowledge in Europe during the two centuries which intervene between the capture of Jerusalen in 1099 and the withdrawal of the Crusaders from the shores of Palestine in the early

years of the fourteenth century? An answer to this question—and it is a very big question—is attempted by Dr. John Kirtland Wright in a noteworthy volume, conspicuous for its searching and thorough scholarship, which was published last year by the American Geographical Society of New York under the title 'The Geographical Lore of the Time of the Crusades.'

In the first part of this very welcome volume (pp. 1–129) the author sets forth certain necessary prolegomena: the geographical knowledge of the Ancient World, of the Dark Ages, and of the Moslems; the sources for the period 1100–1300; and the position of geography in the mediæval scheme of knowledge. In the second part (pp. 134–361) he presents a conspectus of his period under such subject headings as Cosmogony, the Atmosphere, the Waters, the Lands, Astronomy, Cartography, and Regional Geography. In the first part he has, in the main, summarized the work of other scholars. In the second part he has, in a manner for which no commendation is too high, brought under review the whole literature of the period. His chapter on Sources (Part I. IV.) is supplemented by a bibliographical appendix (pp. 491–502), and by a most trustworthy bibliography (pp. 503–543), which would by themselves be worth the money asked for the entire book. So profound an investigation—for there are in addition over one hundred pages of notes and references—should proclaim this work the most remarkable of its kind since Beazley's 'Dawn of Modern Geography'; and should demand recognition as a point of departure by all who would approach the same field of inquiry.

In view of Doctor Wright's carefully documented conclusions, it is strange to recall what the older writers upon Mediæval culture have taught concerning pre-Columbian ideas—a flat Earth, a rigid dome-shaped firmament, a series of revolving spheres, small heavenly bodies answerable only to this planet's needs, illimitable ocean rolling like a river around the planetary disk, and a credulous belief in the existence of strange men and stranger monsters—Prester John, Gog and Magog, Anthropophagi; not to speak of the floating islands of the West, the Gates of Hell, and the Four Rivers of Paradise.

Doubtless there was much superstition, much credulity, especially in an age when masses of uneducated folk were struggling to understand the mysteries of a religion whose spirituality was at times beyond their grasp. Dr. Wright is wise in warning his readers that the culture which he has so skilfully disinterred was not the commonly accepted knowledge of the multitude. But the same thing holds true of every generation. Readers of the volume at present under review will not be the less interested in the scientific concepts of the twelfth and thirteenth centuries because they were enunciated by pioneers in the intellectual forefront of their age.

Leaders of thought in the Crusading era thought of the Universe as a hollow sphere and of the Earth as stationed at its centre. Further, they thought of the Earth as spherical in shape and perpetually poised in a state of unchanging immobility. Only the ignorant and uninitiated were puzzled to know how so ponderous a mass could remain steady without a pedestal, base, or supports. In answering such the scholastic philosophers would have said, "Suppose that the Earth were hollow like the Universe, and that perforations in its surface allowed ourselves and the Antipodeans to drop boulders in each others' direction. Then it follows that these missiles could never go farther than the centre; for the centre would mark the end of the longest fall or descent practicable from every point of the circumference."

Of the size of the Universe opinions were naturally vague, though the elect were at one in their insistence upon its fathomless magnitude. William

of Conches, tutor of the Plantagenet princes, in his efforts to demonstrate the insignificance of our planet, gave it as his opinion that the Sun was eight times larger than the Earth. Gossouin's ' L'Image du Monde,' a work encyclopædic in character written in 1245 and extensively copied, gave the magnitude of the Sun as $166\frac{3}{20}$ greater than the Earth ; the fraction perhaps being an artless device to give the calculation verisimilitude. The same work suggested that the Earth, if viewed from the confines of the Universe, would appear smaller and fainter than the tiniest star ; and that a hundred years of uninterrupted travel " at the rate a stone falls to the ground " would be insufficient to traverse the distance between the centre of the Universe and its circumference.

The sphericity of the Earth, one of the few points upon which all great teachers agreed, was in the opinion of Sacrobosco amply demonstrated by the difference in the time of eclipses to east and west of a selected position ; by the difference in the visibility of stars ; and by the ability of a look-out at the masthead of a ship to see objects invisible to an observer on deck. Further proof was required by those who thought that a fluid element would slide from the surface of a sphere. " Not so," was the reply ; " the part is not greater than the whole. Observe the shape of a drop of water. Cannot the source of all waters assume the shape of its tiniest particle ? "

This spherical Earth Sacrobosco and his contemporaries divided into five zones or climates, in which subdivision they were aided by their complete understanding of the Celestial Poles, the Arctic and Antarctic Circles, the Tropics, and the Ecliptic. Beginning at the north, first came the Zone of *Septentrionalis*, which took its name from Ursa Major ; secondly, *Solstitialis ;* thirdly, *Equinoctialis ;* fourthly, *Brumalis* or *Hiemalis ;* and fifthly, under the Southern Pole, *Australis*. Concerning these zones there was considerable divergence of opinion. The majority of the experts, however, found common ground in the belief that *Solstitialis* alone was inhabited. This zone, or that part of it which was *terra firma*, went by the name of " Man's Dwelling-place " ; Oikoumene, to use the scientific term. In this Oikoumene were three land-masses or " corners," to wit, Europe, Asia, and Africa. The two latter were calculated to be of immense size, and their unexplored areas were referred to generically as " India " and " Ethiopia." But what of the rest of the Globe or " Orbis " ? Here, indeed, was room for almost infinite speculation, and space forbids any attempt to classify conjectures. Vulgar credulity simplified the problem by defining *Septentrionalis* and *Australis* as too cold for human kind, and *Equinoctialis* as too hot. But this was altogether too facile for the scientists. Besides, the theory left *Brumalis* unaccounted for. By analogy *Brumalis* should be as suited to the support of life as the Oikoumene itself. But if that was the case, why was it so entirely cut off ? Why had not the Antipodeans, if such people existed, made their presence known ? " Clearly," argued one school of thought, " because *Equinoctialis* cannot be traversed." But that view, if dying hard, was none the less moribund. The advanced Moslem thinkers asseverated that the whole of Ethiopia might well prove habitable. No reconciliation of conflicting views could be reached before the coming of the explorers ; but something like a compromise was reached in a creed which balanced the three continents in the Oikoumene with a " Fourth " continent in the south Temperate Zone. This unknown continent was believed to be separated from the older world by numberless leagues of ocean ; and out of the statement of the scientists that, if it contained inhabitants, these inhabitants would probably prove different from the known races of mankind, fertile imaginations pictured those human monstrosities which figure in the

oldest extant maps. Bishop Grosseteste, who entertained small hopes that the Fourth Continent would ever be reached, ingeniously conjectured that the eccentricity of the solar orbit was such as to bring the Sun "five degrees" nearer the Earth in the southern hemisphere, and so render *Brumalis* unfit for human habitation. This was a conservative view for so modernist a thinker, and may perhaps be explained by an unwillingness on the good prelate's part to believe that any of this world's inhabitants should be beyond the reach of the gospel of Christ.

Sufficient hints, perhaps, have already been given of astronomical knowledge in Grosseteste's day. For the determination of latitude the experts advised an altitude observation of the Sun at noon either at the Spring or Autumn Equinox, the figure of the observed angle being deducted from 90 degrees*; or, alternatively, an altitude observation of the Celestial Pole which would give what was required without further trouble. The Toledo Tables gave rules for the determination of longitude based on eclipses; but apart from Armillary and other dials, little progress, if any, was made in devising instruments for the measurement of time. Those who have followed the argument thus far will not be surprised to learn that Bishop Grosseteste discussed, with his usual lucidity, the Precession of the Equinoxes. He found it difficult to dispute the logic of hard facts, but thought the doctrine hard to reconcile with the universally accepted belief in the immobility of the Earth.

The Winds, the Tides, and the Mountains evoked many shrewd expressions of opinion from these mediæval pioneers. Bernard Sylvester of Tours, whose 'De Mundi Universitate' was composed about the middle of the twelfth century, attributed the tides to lunar causation, and explained that the Moon, as the Earth's nearest neighbour, must clearly exercise the power of attracting and repelling the waters of our planet. In his willingness to concede that this argument would give the moon a pull over the Earth as well as over the sea, he came very near to an even greater discovery; but he stumbled on the Newtonian threshold and did not cross it. William of Conches strikes a twentieth-century note in his statement that discrepancies between the most accurate calculations and the ascertained hour of high tide may in part be accounted for by the irregularities in the ocean floor. The same author has a very sapient conjecture about winds. These, he remarks, may, for all we know, be as periodic as the tides, but may blow at a higher altitude than the observer, and so go unnoticed.

Alfred of Sareschel, an Englishman like Bacon and Grosseteste, classified mountains under two categories, those caused by the upheaval of land masses in convulsions analogous to what men call "earthquakes," and those caused by the denudation of the normal surfaces through the agency of waters; a reflection which, as Dr. Wright justly observes, will suffice to show that in the age of the Crusades the modern science of geomorphology had already emerged from its infancy. The 'Gesta Abbatum Trudonensum,' describing the crossing of the Great St. Bernard in 1128, strikingly illustrates the effect on the mediæval mind of the immensity of mountains in comparison with man; but the 'De Imagine Mundi,' another favourite encyclopædia of the period, insists that the mightiest mountains are small in contrast with the Earth's mass, as small as the fingers of the human hand in comparison with a big ball which they can hold but cannot encircle.

In 'Gesta Danorum,' by Saxo Grammaticus, may be found proof conclusive

* This tends to show that if any Arabic tables of the Sun's declination were available, they were not widely known or utilized.

that the inquiring minds of our period had carefully observed and drawn useful inferences from the motions of glacial ice ; but perhaps the most remarkable contemporary passage having reference to mountains is that in which a contributor to 'L'Image du Monde' records his experiences upon a visit to the summit of Etna (Mongibel). The fire issuing from the crater, he says, quickly turned to smoke and vapour ; the volcanic rock appeared to him like "foam of iron" (*escume de fer*) ; the land about the volcano wore the appearance of being blasted and burnt ; and as he descended the mountain side he was startled by the rumbling sound of thunder in the clouds below his feet.

From these few samples the reader may be able to gauge the scope and variety of Dr. Wright's illustrations. In number the instances selected do but touch the fringe of his extensive scheme ; but they may serve their purpose in directing attention to a new view of a momentous epoch in the history of human thought.

In a work so comprehensive in scope and based on so wide a range of authorities, there should be plenty of room for disagreement ; but the present writer has only two criticisms to advance, one affecting the first part of the book, and the other the second.

In the prolegomena to his thesis Dr. Wright would appear to be heretical in his views respecting what may be called (for want of a better phrase) the Apostolic Succession of Geographers. Instead of following the trend of science from Byzantium eastward to Baghdad and Isfahan, then westward to the Pillars of Hercules, and so to Cordova and Toledo, he erects his edifice almost wholly in Western Europe with borrowings from Islam. On such foundations the edifice seems unstable, and in chapter ii. positively oscillates. In this section of his work Dr. Wright passes from the heritage of Antiquity to a consideration of the Early Christian Church, which he weighs in the balances and finds wanting. "The earlier Fathers of the Church," he writes, "whatever may have been their merits as theologians and dialecticians, were not distinguished by an ability to understand the truths of natural science or to combat error in that field." Such reasoning, surely, is foreign to the whole inquiry. Before the Fall of Rome the Christian Church, in its efforts to instruct civilized man in what it believed to be the truth, was at times more rationalistic than the men of science, as, for example, when it combated the Aristotelian doctrines of astrology. After the Fall of Rome its efforts were turned in a new direction, and its mission was to teach Western Europe, not geography, nor yet astronomy, but "to do justly, and to love mercy and to walk humbly before God." Augustine, who in these pages comes in for some hard knocks, stood at the parting of the ways. Rome was not yet fallen, but its days were numbered. Augustine wrote his famous work to prove that the perils of the Empire were not attributable to the forsaking of the old gods and the adoption of Christianity. To set the 'De Civitate Dei' alongside of Aristotle's Meteorology and, with Dr. Wright, to deduce from the contrast a blameworthy obscurantism in Patristic Literature is straining a weak thread to the breaking-point. The truth is that, from 476 A.D. to the tenth century or later, Western Europe (apart from Spain) was but an annexe to the scientific world ; and the influence of such writers as Macrobius, Solinus, and Martianus Capella upon the Monastic Schools of the Dark Ages might have been consigned to an appendix without adding anything but strength to Dr. Wright's main contention.

In the second part of his book Dr. Wright to the present writer seems rather to underrate the importance of the Norman conquest of Sicily. This event, which occurred at much the same time as the capture by Western Europe of

Jerusalem and Toledo, may be regarded strategically as the centre and heart of a triple attack upon the Moslem world. Under the wise rule of King Roger and his immediate successors the south of Italy and Sicily enjoyed a period of prosperity and happiness. The equal and tolerant government of the Normans, far surpassing anything at that day known in Europe, enabled the Saracens, the Greeks, and the Italians to live in harmony elsewhere unknown. Roger II. can only be described as a devotee of Geography, and at his brilliant court there assembled many of the most notable scholars from Toledo and Cordova, including the great Edrisi (Al-Idrisi). Celestial spheres were constructed, and geographical works compiled. But more than this. In an island, centrally placed in the most important sea high-road of that age, the mightiest seamen living met and learnt to appreciate the most learned astronomers and mathematicians. The result, it can hardly be doubted, was to revolutionize the whole art of Navigation ; to apply to the problems of the mariner those accurate celestial observations which would enable him to push out into the great deep, to lose all sight of land, and at length come to the desired haven where he would be.

If at this point we draw our criticisms to a close, perhaps Dr. Wright may be induced at not too distant a date to add yet another to this admirable series of handbooks, and trace for us the influence of Sicilian science, first upon the maritime republics of Italy and then upon the charting of the outer seas and the exploration of the World.

GEOFFREY CALLENDER.

HYDROLOGY OF THE RHÔNE

Le Régime du Rhône. Etude hydrologique.— Maurice Pardé (Université de Lyon. Institut des Etudes rhodaniennes. Etudes et Travaux. Tomes I. and II.). Première Partie, Etude Générale (pp. xiv. + 884) ; Deuxième Partie, La Genèse des Crues (pp. 440). Lyon : Pierre Masson ; á la Faculté des Lettres. 1925. 10 × 6½. *Diagrams.* 12*s.*

Le Calcul des débits du Rhône et de ses affluents. By the same. Grenoble : Institut de Géographie Alpine. 1925. Pp. 168. 2*s.* 8*d.*

IN publishing these volumes Dr. Pardé is careful to explain that the data on which they are based cannot be regarded as at all adequate for a precise presentation of his subject. Records of many of the facts which have to be considered in studying the hydrology of a complex river system are either non-existent or exist in a fragmentary form only. The mean discharges of certain rivers in the system and the flood discharges of nearly all have never been determined. In the areas of greatest precipitation, in the high mountains, there are no actual measurements of rainfall or of snow, and information regarding the surface distribution of permeable and impermeable strata is also incomplete. In short, of all the required data, only the records of water surface levels can be regarded in general as sufficiently precise.

It follows, therefore, that in the absence of actual measurements, the discharges of the various channels have to be deduced indirectly, either from a general consideration of the climate and morphology of their catchment areas, or by using discharge formulæ to interpolate between the available measurements ; but the author hopes that the results he has obtained will be of use not only in meteorology but also in such practical questions as the prediction of floods.

Contrary to a very prevalent belief, there exists no treatise giving a general survey of the *régime* of the Rhône, nor does any one work give a general analysis of the hydrology of the river system as a whole, though individual portions have been separately dealt with. The desire to supply this want has led Dr. Pardé to publish the results of his research, which he claims as, at least, a preliminary to the more precise investigation required for a complete presentation of his subject. The *Institut d'études rhodaniennes*, recently constituted in the University of Lyons, is a means towards this desired end, and these volumes are the first to be published under its auspices.

Apart from its general interest as a study in hydrology, an investigation of this kind has a direct bearing on the economic development of France. The Rhône, by reason of its large volume, its steep gradients, and its comparative freedom from marked fluctuations in mean discharge, is a valuable potential source of power which would be exploited, one may suppose, mainly by means of hydro-electric installations. There are also irrigation possibilities in certain areas at present unproductive through lack of water. Such schemes call, no doubt, for expert investigation, but an essential preliminary to such investigation is a knowledge of the factors affecting the *régime* such as is afforded by these volumes.

The first volume of the series is devoted to a general study of the *régime* of the river system, which for this purpose has been divided into various sections. The first is the Swiss or Alpine Rhône from the source to the junction with the Lake of Geneva, with a sub-section dealing with the lake and its affluents. The second section, the Upper Rhône, from the junction of the Arve to that of the Saône, together with its affluents, affords examples of three distinct types of *régime*, corresponding to three varieties of relief. These are the *régime alpestre* represented by the Arve ; the *régime préalpin* represented by the Fier and the Guiers ; and the *régime jurassien* represented by the largest affluent of this section, the Ain. The next section, the middle Rhône, lies between the junction of the Saône and that of the Erieux, and includes its two principal affluents, the Saône and the Isère, the former sluggish and essentially rain-fed, while the latter is torrential and mainly snow-fed. The last section is the Lower Rhône, between the junction of the Erieux and the sea, including numerous affluents which are divided into three groups according to their catchment areas.

The general study of the hydrology of these sections proceeds on practically identical lines, the affluents and the main river being treated separately. The influence of relief, climate, geological structure, etc., is fully discussed, and leads to consideration of the discharge and particularly of the seasonal distribution of floods and of low-water periods. In the rivers which drain Alpine catchment areas and which are mainly fed from melting snow and glaciers, the rotation of high and low supply is comparatively simple, and follows the seasonal variations of temperature. Lower down the rotation is complicated by the entry of rain-fed affluents in which the seasonal variation of discharge is entirely different from that of snow-fed streams. Just below Geneva, all high floods, with very rare exceptions, occur between June and August ; at Seyssel the winter floods form one-third of the total number ; at Sault, below the junction of the Ain, winter floods are twice as numerous as summer floods ; and below the junction of the Saône the summer floods become the exception. Further down appears a remarkable inversion of seasonal *régime* due to the influence of rainfall in the Cévennes on the right-bank affluents. These catchments are subject to sudden and torrential downpours, and the resulting

floods cause the ordinary winter floods to take second place, the season of high-water-level occurring usually from mid-September to the end of October.

From this brief sketch of the scope of this volume it will be seen that it deals with a very complex system of interlacing factors; these are presented with great clearness, and the effect of each on the *régime* of the various sections is well brought out. As a preliminary to further investigation, Dr. Pardé's work will be invaluable to those who carry forward his research, and his compilation of existing records will greatly simplify the modification of his results in the light of more precise data.

In the first volume the factors governing the occurrence of high and low water are dealt with in general terms (except for the Alpine Rhône and the Saône), and the discharge volumes are quoted without much explanation of their derivation. The second volume of the series deals in detail with the genesis of the floods, while the third, a supplementary volume, explains the methods adopted for calculating or estimating the discharges.

The floods of the Rhône basin are designated according to the origin of the precipitation from which they are derived: 1°. *océaniques;* 2°. *méditerranéennes cévenoles;* 3°. *méditerranéennes extensives;* and 4°. *générales.* The first are caused by the humid west and south-west currents from the Atlantic, and occur during the cold season from October to March, and affect principally the river-basins upstream of Lyons. Floods of the second type have already been referred to as causing an inversion of *régime* below Lyons. They are caused by heavy precipitation from clouds driven in by south and south-eastern winds from the Mediterranean, and affect the affluents issuing from the eastern slopes of the central massif. The origin of floods of the remaining types is too complex for brief explanation, but the third type may be roughly described as due to secondary disturbances superimposed on those causing floods of the second type during a short three weeks following late October; while the fourth type is caused by coincidence of high-water peaks due to the other types. The meteorological phenomena of each type are fully described in detail, and the effect on the various catchments is explained and analyzed, the whole volume forming an able and interesting exposition of flood causation.

The third volume opens with a *résumé* of well-known methods of river gauging, which is followed by a brief description of discharge formulæ such as those of Bazin, Manning, Kutter, etc. Then follows a detailed explanation of the methods adopted for arriving at discharge curves for various selected stations. These consist generally of plotting the available gaugings and filling in the gaps by means of discharge formulæ, or by considering the run-off in terms of the rainfall, or by comparing the total discharge at a given point with the sum of its component parts. The curves also are modified to suit variations in *régime* affecting the coefficient of rugosity and variations in cross-section which alter the hydraulic radius. Finally, curves are arrived at which within certain limits of error are regarded as satisfactory. The factors governing the discharge of the Rhône and its numerous affluents are so varied in character that it would serve no useful purpose to attempt a general summary, and all details are fully set forth in this volume.

Each of the three volumes of the series contains its own special bibliography, and an inspection of the titles of the numerous documents involved gives a slight indication of the labour expended in the compilation of a remarkable work which may well serve as a model for other similar investigations.

Dr. Pardé's work has its application to river systems other than that of the Rhône. A survey of the water resources of this country is already overdue, and

the pressure of industrial competition, together with the imperative need for cheaper power, daily emphasizes its importance. It is certain that this pressure will not permit of a prolonged survey carried out with all the precision of accurate measurement; and we have here a useful object-lesson of the use that can be made of data admittedly fragmentary, but sufficient for a preliminary investigation and affording an indication of the data which have to be collected, and on which work can be most usefully concentrated. N. F. M.

REVIEWS

EUROPE

The Town of Cambridge: A History.— Arthur Gray, M.A. Cambridge: W. Heffer & Sons, Ltd. 1925. 10 × 6, pp. ix. + 204. *Illustrations.* 10*s.* 6*d. net.*

AFTER having delved into the early history of the University, Dr. Gray has now devoted his attention to the town of Cambridge. The result as presented in this book is of much interest, particularly the chapters on its early history. Despite a determined attempt, he has not of course been able to exclude altogether the University from his pages. Apart from indirect influences, much of the town's story consists in its continued struggles with the rival authority within its bounds, but the town can at least claim a more considerable antiquity. A Roman camp guarding the bridge on the so-called *Via Devana* stood where Castle Hill, itself of Norman origin, now is. Dr. Gray further seeks to show that a Roman town may have grown up around it. Bede, in his 'Ecclesiastical History,' refers to "a certain desolate little city situated not far away [from Ely] which in the English language is called Grantacaestir." This Dr. Gray identifies with Cambridge. King Alfred also writes of it as a "wasted chester." If this is correct, in the succeeding centuries the site seems to have been abandoned. By the year 875 however the bridge had been rebuilt, and an Anglo-Saxon settlement, known as Grantebrig, had grown up.

The book also gives much information on Anglo-Saxon and Danish times, revealing incidentally a curious duality in the settlements north and south of the river, a duality still reflected to some extent in their outward appearance. After the Conquest the great events, apart from the juridical development of the borough, are the founding of Sturbridge Fair in 1211, and the coming of the clerks. From early times its site at the crossing of a Roman road over a navigable river had brought trade to Cambridge. In three centuries it had become, in Queen Elizabeth's words, "by far the largest and most famous fair in all England." The early history of the University, and the reasons for the selection of Cambridge, are obscure, but they also point to the importance of the town as a recognized centre. From the first clerks and citizens were in conflict: then the University, chiefly through the Chancellor's Court, gained and kept the upper hand till the nineteenth century. The situation of the railway station remains as a monument of these conflicts of interests. Now they have been composed, and town and gown will find much of interest in this impartial history; not least in the several reproductions of early prints, including one of the Round Church before its "restoration" in the nineteenth century. G. R. C.

The Mountains of Snowdonia in History, the Sciences, Literature and Sport.— Edited by **Herbert R. C. Carr** and **George A. Lister.** London: John Lane. 1925. 9 × 6, pp. xviii. + 406. *Maps, Portrait, and Illustrations.* 25*s. net.*

The rival claims of the Lake District and of North Wales to be the most beautiful mountain region in Britain may be perhaps disputed. Snowdon itself is a finer mountain mass than any in Cumberland, and now the Snowdon region has been described in all its aspects in a single volume, to which the voluminous literature about the Lake District can offer no comparison. 'The Mountains of Snowdonia' is of necessity a compilation, and there is unavoidably a certain lack of balance and proportion between the various sections, and a small amount of overlapping and repetition. The editors, who contribute some of the chapters themselves, have been at pains to secure the most competent authorities on the different subjects. The book is divided into four parts: Historical, Literature, Science, and Sport. Not the least interesting chapter is entitled "The Industrial Activities of Snowdonia," in which we learn that in the course of a year or two all the important towns from Crewe to Holyhead will be supplied with hydro-electric power derived from the waters of Snowdonia. We are not told how far the pipes and dams have disfigured the face of the country. There is a most vivid description of the Penrhyn Slate Quarry, that enormous excavation extending over nearly 200 acres. Chapters on Geology and on Bird and Plant Life are full of information and unusually intelligible to laymen in those subjects. It is rather to be regretted that Sir J. B. Farmer is so very precise in naming the localities of rare plants. The editor, Mr. Carr, writes an agreeable chapter on mountaineering or (more exactly) mountain walking in the district. Mr. Carr, who is himself a distinguished cragsman, was involved in a serious accident near Snowdon last autumn. His companion was killed and he himself was picked up after a long exposure in an almost hopeless condition. It is satisfactory to know that he is making a good recovery.

There is a small-scale geological map, and some ingenious sketch-maps, the usefulness of which is somewhat lessened by the method of reference. A general map of the district would have added to the value of the book. There are a number of interesting illustrations. A. F. R. W.

Places and Place-names round Alyth.— **James Meikle.** Paisley: Alexander Gardner. 1925. 9 × 5½, pp. 204. 9*s. net.*

The growing interest in, and realization of the importance and value of the study of place-names are shown by the numerous works on the subject that have recently appeared. That place-names have a geographical interest goes without saying. Although the purely linguistic aspect of the subject generally claims most attention, yet the topography of a district, as throwing light on the meaning of place-names, cannot be ignored. This is well shown in the illustrative part of Mr. Meikle's book. In a critical and learned introduction he points out how three linguistic elements, Pictish, Gaelic, and English, enter into the formation of the place-names of the district of which he treats—Alyth, in Perthshire. He justly insists on the essential importance of phonetics in the interpretation of names. A good illustration is given in his treatment of the word Alyth itself, which he derives from the Pictish *arleithio*, "over the moistening or softening," in the sense of *a place overlooking soft ground subject to flooding;* more probable than Sir John Rhys' suggestion that the same word is found in the Welsh name *Elaeth*, a sixth-century saint. Rhys identified Alyth with Allectus, the Co-Cæsar in Britain with Carusius, whom he assassi-

nated in 294 A.D., reigning alone as Cæsar until A.D. 296, when he was overcome by Constantius Chlorus, who reunited Britain to the Roman Empire. Even though it be unsupported by further evidence, the inference that Allectus was a native of Alyth is one naturally interesting to an inhabitant of that place. The book is well printed, and there are added lists of Pictish, Gaelic, and English (including Scandinavian) words, and an appendix. E. A. P.

Along the Pyrenees.— **Paul Wilstach.** London: Geoffrey Bles. 1925. 9½ × 6½, pp. 302. *Maps and Illustrations.* 16*s. net.*

Internal evidence shows that the author of this work is an American, to whom, perhaps, the Pyrenees represent a remoter region than they suggest to an Englishman. He is inclined to approach the subject in the spirit of an explorer on the brink of some strange and venturous journey, and his rather flamboyant journalistic style is at times a trifle irritating to an English reader. The thrill to which he confesses at the sound of rather familiar place-names has a somewhat naïve effect. Nor are his statements always accurate; for example, he asserts, and repeats the substance of the assertion later on, that "the stretch between the Col du Pourtalet and the Cerdagne may be crossed only at rare intervals, on foot or mules, in single file." Though he mentions the Val d'Aran, he cannot, apparently, have explored it very thoroughly, or he would have ascertained the existence of a good carriage road across the Spanish frontier at a point where, according to him, no such thing exists. Five chapters are completed before Mr. Wilstach brings us actually up to the range, which he approaches by way of Toulouse, Carcassonne, and Perpignan, to each of which towns he devotes a chapter. The most interesting part of the book will probably be found to be the account which the author gives of his visit to Andorra, where, indeed, he may be said to have got off the beaten track, though even here he managed to find a motor coach to convey him. For the most part, he seems to have stuck to the railway, and we would suggest that to write anything new about the Pyrenees such methods of travel must be discarded. Mr. Wilstach has, however, a quick ear for local legends and historical anecdotes, and generally contrives to impart a good deal of freshness to his descriptions, while the book is illustrated with some excellent photographs.

G. M. G.-H.

Unknown Sweden.— **J. W. Barnes Stevenji.** London: Hurst & Blackett [1925.] 11½ × 9, pp. 327. *Forty-seven Illustrations and a Map.* 21*s. net.*

Mr. Stevenji begins his book, rather surprisingly, with three chapters on the Scandinavians in Yorkshire and East Anglia. Then, starting from Malmö and ending at Abisko in Lapland, he conducts his reader over practically all Sweden, describing as he goes everything of interest and much that is known as well as unknown. Though he writes with considerable knowledge and great enthusiasm, 'Unknown Sweden' will scarcely supply our need for a good popular book on Sweden. It contains too much. The material is often presented in a very confused form—and in the chapter entitled "St. Bridget: Vadstena Nunnery" has never been arranged at all—while the language needs revision and condensation.

When the author describes modern scenery, conditions, and customs, as in the chapters on Jämtland and Lapland, he writes well. His digressions into archæology and ethnology, however, are both too frequent and too inaccurate. He is anxious to show that Yorkshire was colonized from Sweden even in the Stone Age, and that traces of the early Scandinavians, such as grave-mounds,

are found all over the world; but instead of proving these theses, he keeps on affirming them explicitly and weakening them implicitly all through his book. Not content with deriving *London* from Norse *lundr* (a sacred grove) and referring to dolmens as "those primitive domiciles of our early forefathers," he writes, "The great use of diphthongs among the cockney . . . is, I believe, of Basque origin, and one of the survivals of the old Basque tongue, which was probably once spoken over the whole of Britain and many parts of Europe," and "it is not improbable that the worship of the sun-god was introduced by the people of Atlantis or some other great race of navigators." That sort of thing, especially in large quantities, does not improve a book written chiefly for tourists, or indeed any book.

Among its merits 'Unknown Sweden' possesses the valuable quality that it will probably make many of its readers visit Sweden at the first possible opportunity. The photographs are particularly good, and the map is adequate.

E. L.

The Polish Handbook: A Guide to the Country and Resources of the Republic of Poland.— Edited by **Francis Bauer Czarnomski.** London: Eyre & Spottiswoode, Ltd. 1925. $7\frac{1}{2} \times 5$, pp. xlvi. + 704. *Four Maps.* 10*s.* 6*d. net.*

This is the first serious work of reference on Poland of to-day which has appeared in this country. As such it is to be welcomed, and in it is to be found much information that will be invaluable to the business man and traveller, and indeed any one who is interested in the new republic. It is likely to be particularly useful, since it deals not with generalities but gives specific and detailed information on every aspect of Polish affairs—government, history, geography, education, agriculture, timber, minerals, trade, communications, labour and social welfare, finance, and national defence; while the chapter dealing with cultural life has interesting sections on Polish literature and drama, and the Press. There is a good general map, in addition to other maps showing railways, administrative divisions, and the State oilfields. The editor is to be congratulated on his industry and enterprise, and on the admirable way in which he has arranged the mass of information he has acquired. The book has a good index, which adds considerably to its value as a work of reference.

O. R.

The Dawn of European Civilisation.— **V. G. Childe.** London: Kegan Paul & Co. 1925. New York: Alfred A. Knopf. $9\frac{1}{2} \times 6$, pp. xvi. + 328. *Sketch-maps and Illustrations.* 16*s. net.*

The number and variety of discoveries made in prehistoric archæology during recent years are so great as to be rather bewildering to any one but an expert. Any attempt, therefore, to synthetize and co-ordinate them is to be welcomed. This work is a praiseworthy effort to make such a synthesis, and the author's object is to show the relation and bearing of the material at his disposal in producing the early civilization characterizing the Bronze Age in Europe. His industry has obviously been great in going through all the literature of the subject, comparing the results, and examining collections; and he shows a sober judgment in the inferences he makes and the views he expresses. The tentative character and not very convincing nature of some of his conclusions are no doubt largely due to paucity of material and chronological uncertainty. But if his exposition of the subject is considered without bias, we must admit that he makes a strong case for his opinion regarding the respective influence of East and West on the production of the European

civilization that had evolved in the Early Bronze Age. Avoiding the extremes of Orientalist and Occidentalist alike, he claims that while "the West was indebted to the East for the rudiments of the arts and crafts that initiated man's emancipation from bondage to his environment, it was no slavish imitation, but, adapting the gifts of the East, united the contributions of Africa and Asia into a new and original whole capable of developing on its own lines."

Apart from this the work will be welcome and useful to the student in giving connected and succinct accounts of cultures, as, for example, those of the Black Earth and Danubian regions, which can only be studied by reference to a number of publications by no means readily accessible to the English reader. The publication of the book is, in fact, most opportune, and can hardly fail to be of service to all students of prehistoric archæology.

There are numerous good and clear illustrations in black and white, and a series of maps (which would have been all the better if made on a larger scale) showing the distribution of cultures in Europe from the first half of the third millennium B.C. down to 1600 B.C., when the Early Bronze Age may be said to have become established over the greater part of the Continent. E. A. P.

ASIA

A Century of Excavation in Palestine.— R. R. S. Macalister, Professor of Celtic Archæology, University College, Dublin. London: Religious Tract Society. [1925.] 9 × 5½, pp. 335. *Thirty-six Illustrations.* 10*s.* 6*d. net.*

"The requirements of uniformity with a companion volume on Egypt ('A Century of Excavation in the Land of the Pharaohs') impose its title upon this book; but to some extent it is a misnomer." Thus in the opening lines the author disarms the obvious and inevitable criticism that it is now but sixty years since the first attempts were made in modern times to find out by digging the underground secrets of the Holy Land. In this volume we have an excellent popular account of all the work done by one who more than any other can write from personal knowledge.

The first chapter gives a short history of the various excavations which have been undertaken in Palestine. After the preliminary work of Robinson, Tobler, Van der Velde, and De Saulcy had shown the world how limited our scientific knowledge of this land was, the Palestine Exploration Fund, founded in 1865, made the first comprehensive attempt to systematize and verify the scattered information of previous workers. Some five years later Lieut. Warren (now General Sir Charles Warren) made the earliest excavations in the neighbourhood of the Holy City. Viewed from the present standpoint the tunnelling he did around the Haram or Temple Area was costly, dangerous, and unscientific (as regards archæological results), but it had a considerable air of romance. The appearance of Warren's deep shaft and gallery made near the south-eastern corner of the Haram forms a device on the cover of the *Quarterly Statement* down to the present time. After this excavations were not resumed in Palestine for another twenty years, when, in March 1890, Dr. (now Sir) Flinders Petrie made a brilliant six weeks' reconnaissance of Tell-el-Hesy (Lachish) and "laid the foundation of the study of Palestine ceramics." From this time onward—except during the War—an ever-increasing number of societies and excavators of various nationalities have been at work among the ancient sites of Palestine. Jerusalem, Lachish, Moresheth, Gezer, Jericho, Megiddo, Samaria, Bethshemesh, Askalon, Bethshean—to mention the ancient names of only a few of the sites—have each in turn been more or less

thoroughly investigated by workers from various lands, and the results have appeared in several periodicals and not a few large monographs.

In this volume Prof. Macalister has very successfully summarized the broad results of all for the benefit of those who are more concerned with them than with technical detail. He has classified these results in four chapters—Topography, Political History, Cultural History, and Religious History—and no one reading his pages can fail to be impressed with the total result. Naturally the latest work of the Palestine Exploration Fund, which is new to most, receives specially full treatment. It must be admitted there is little indeed of a showy kind. The number of actual inscriptions is small and the level of culture revealed is surprisingly primitive when we consider the enormous influence upon the world of thought of the literature which has arisen in so small and so little cultured an area. Every year, however, continues to add to our knowledge, and there can be no doubt that when an actual century has been spent in field work in Palestine the contribution of excavation to our knowledge of the Archæology and History of this land—and to our understanding of the Old Testament—will be vastly greater.

It only remains to add that the illustrations, many of which are new and original, greatly add to the understanding of the text and also to the attractiveness of an unusually fascinating volume. E. W. G. M.

Peking to Lhasa : George Pereira.— Compiled by **Sir Francis Younghusband, K.C.S.I., K.C.I.E.** London: Constable. 1925 [1926]. 9 × 5½, pp. x. + 287. *Maps and Illustrations.* 18*s. net.*

In compiling the narrative of the last journeys of General George Pereira in the Chinese Empire, Sir Francis Younghusband has been well advised to adhere very closely to the plain record of events contained in the traveller's diary. To have attempted to do more would have been to fail to present a true picture of the man and of his journeys. Pereira would never have travelled for the purpose of writing a book. If he could have been persuaded to write an account of his explorations, he would certainly have despised anything of the nature of a popular style and would probably have been quite indifferent as to whether any one read his book or not.

He could, indeed, relate to those who he knew would be interested incidents of his journeys, told with that unfailing sense of humour which was somehow different from anybody else's sense of humour. His power of seeing the amusing side of things was undoubtedly a great help to him in times of difficulty, but he always kept before him also the duty of a traveller in remote places to observe and record with conscientious accuracy everything worth noting in the country and the people. Probably he would have added something from memory to this narrative if he had written it himself, but as he did not live to do this, those who knew him will be grateful to Sir Francis Younghusband for producing a book which they will feel tells the tale almost in Pereira's own words.

If a small criticism of the compiler of the book can be made, it is that he has not been entirely successful in surmounting the difficulties of printing and proof-reading where Chinese names are concerned. Some of the mistakes are of no great importance, but on p. 267 there is a confusion between Shensi and Shansi which makes the passage unintelligible. The first of the two provinces mentioned here should evidently be Shansi. It may also be suggested that in a book which will doubtless be read by many who are unacquainted with China, it would have been useful to explain some of the Chinese terms used

in the diary. For instance, the general reader will probably not be aware that "hung-hu-tzu" means "brigand," and will certainly not know that "pu-sa" is "an image," while even a lifelong resident in China might not realize that the Lolo "horn" is a peculiar style of hair-dressing.

The story told in the diary is that of a great traveller who had probably travelled more widely in the Chinese Empire than any one else who ever lived. It is an account only of his last three journeys, but it is a wonderful tale of courage and perseverance. The journey from Peking to Lhasa, nearly 6700 miles, would be trying enough to a young man in good health, but Pereira was fifty-six when he started, was permanently lame, and by no means physically strong. To these disabilities must be added the constant anxiety that he would be stopped by Chinese or Tibetans from fulfilling the purpose of his journey—a fate that had befallen every European traveller who had in the past eighty years attempted to reach Lhasa from the east. However, Pereira's attitude towards these difficulties may be summed up in the words of his diary: "I would rather have died in attempting it than have chucked it up from funk." As it turned out there was no real opposition from the Tibetans, but the hardships and fatigues of the road to a man not in good health would have been enough to deter a less resolute traveller. "A frost-bitten foot—quite played out—dog tired—not well and walked only 2 miles—by a very great effort walked 10 miles—very painful cramp in the left leg—feel very limp—a bad touch of sciatica—very weary each day—had to be lifted off my horse on arrival." Such are a few of the entries in the diary that make one realize the conditions of health under which he marched. No wonder that when he at last arrived in Lhasa "with my white beard, very weary but happy," he exclaimed, "I would not make the return journey for a million pounds." For the moment he was thoroughly weary of travel and never wished to see Tibet again.

But this frame of mind did not last long. In Calcutta he was laid up in hospital with clots of blood in his leg. This alone would have made most men think twice before starting on another arduous journey, but on Pereira the enforced inaction had the opposite effect. His old irresistible desire to be on the move again had returned to him. Starting off as soon as he was well enough to leave hospital he went to Burma, and from there traversed Yün-nan from west to east and went on down the Yangtze to Shanghai. Returning by sea to Tonking he again crossed Yün-nan, this time from south to north, passing through the semi-Tibetan northern part of this province to Batang. From Yün-nan Fu he had been accompanied by Dr. Gordon Thompson, and the two travellers went on together into the entirely unexplored country to the north-east of Batang. Their route led through a region infested by brigands and under no settled government, so that they had to write letters to the magistrate at Batang absolving him from all responsibility in case of any harm befalling them. It was only on this condition that the magistrate would let them go on. They were not attacked by brigands, but the journey was a very hard one, and the weather very cold with constant falls of snow. Pereira had not been really well for a long time, and now became seriously ill. Scarcely able to take any food, with no shelter at night from gales of wind and snow but an indifferent tent, he struggled on for six more days, feeling very ill, but still to the very last keeping up his survey and plotting it every evening. On the last day of his life, 19 October 1923, he collapsed by the side of the road, and it was only then for the last 4 miles into Kanze that he consented to Thompson doing the observations for him. He died in the early morning of the next

day. He had gone on to the very end, till he could go no farther. This is what all who knew him would have expected him to do. He lies now in the cemetery at Ta-chien-lu, the gateway between China and Tibet, a fitting resting-place for the greatest of travellers in China. H. R. D.

AFRICA

The Northern Tribes of Nigeria.— **C. K. Meek.** Oxford University Press: Humphrey Milford. 1925. 8½ × 5½, pp. vol. 1, xviii. + 312; vol. 2, viii. + 277. 122 *Illustrations and three Maps.* 36*s. net.*

This is an ethnographical treatise of unusual dimensions and uncommon interest, which, by the diligence of the author and with the support of Sir Hugh Clifford, has grown out of a Census Report. Since, indeed, the Report occupies (as Part II.) only 95 out of some 600 pages in the book, it may almost be said to have been relegated to an appendix. Although it contains much that is of value, and is lacking in the prosaic reliability of a civilized census, most of us prefer manners and customs to numbers and percentages; but the undertaking must not be dismissed too lightly, since it represents a vast amount of devoted work, carried out under difficult conditions, and, as the author points out in his preface, it may serve as a foundation for more precise records in the future. The census, taken in 1921, deals with Area, Population, Race Statistics, Age, Sex, Occupations, Civil Conditions, Religions, and Education. Attention can be given here to a few points only. The total population of the Northern Provinces was approximately ten millions, divided amongst over 250 tribes, and the total area some 250,000 square miles. Density of population ranged from 116 persons per square mile (in Kano Province) to under 7 (in Kontagora). Most numerous were the Hausa (over 3,000,000) and Fulani (nearly 2,000,000). Of the whole population, over 4¾ millions (male and female) were agricultural workers; spinners and weavers follow in point of numbers (640,000), and traders and brokers were also numerous (317,000). We may note that there was only one fortune-teller, who shared his isolation with a sail-maker. Goats head the list of livestock, followed by cattle and sheep. The only mule was in Kano, but he may have since multiplied, by accretion.

It would have required a monumental treatise to do ethnographical justice to the peoples and tribes of Northern Nigeria, and Mr. Meek's book must be judged by its achievements rather than by its limitations. In culture the population ranges from head-hunting negroid cannibals to relatively civilized Muhammadan peoples, with historical records going back some hundreds of years. Even the great accumulation of observations that the author presents to us must be regarded as little more than a blazing of the trail. An army of investigators would be required to occupy and establish the positions to which Mr. Meek has shown the way, and to unravel the complexities which are too numerous and too involved for incidental solution. It is to be feared that no such army will be sent, but the spirit that ensured the publication of this book will help greatly to render any other kind of army unnecessary.

The preliminary description of the Northern Territory, with its geology, hydrographic system, climate, fauna, flora, and other general matters, is followed by chapters on Ethnological Types, History and Tradition, Economic Life and Industries, Social Organization, and Government and Law. These subjects occupy volume 1, and volume 2 deals with Religion, Language and Lore, Ethnological conclusions, and the Census Report. There are maps of Nigeria, of the Northern Provinces, and a language map. The illustrations

are practically all half-tone reproductions of excellent photographs, and number over 120.

The ethnic complexity of the Southern Sudan is well known, and has probably gone beyond the possibility of unravelment. The Hausa—a people, not a race or tribe—are socially and economically dominant, but the Fulani are in chief political control, though not in Bornu. Except in the case of the nomadic section of the Fulani and some Arabs, the negro element is physically predominant, whilst the purest Hamites are the nomadic Fulani. The author gives an interesting account of some phases of the churning process which has gone on in the Territory, and he lays stress on the extent to which, both in ancient and in modern times, the culture and physical characters of the people have been affected by influences from the east. Indeed, he is, if anything, too ready to appeal to the effect of what seems to be, as far as real evidence is concerned, action at a distance. Also, in stating that " there is a growing opinion amongst ethnologists that Central Africa was the cradle of mankind," he must have been misled by his authorities, or his lack of them—writing, as he tells us he did, in Nigeria. The same comment may be made on his suggestion that opinion is coming to regard the pygmy and the negro as the human types from which all others were evolved. There may be some racial questions upon which ethnologists are agreed, but there is no indication of any movement of opinion in the directions suggested.

In the chapter given to economic life and industries, agriculture and metal working receive considerable attention, but the most interesting of all the technological points is one which is, unfortunately, dismissed in three or four lines. It relates to the use of baskets as moulds for making pots. " The Gwari, who are famous for their pottery, commonly use a basket as a mould, plastering the clay on the outside. The Katab also follow this method. In the process of firing the basket is carbonized, the print of the wickerwork being left on the inside of the pot." The author cannot be aware that he here records a method which is scarcely proved to have been used, except in so far as deductions have been drawn from the markings on more or less ancient pots or potsherds. The method is, moreover, one of some importance, since it has often been suggested that pottery first arose as a result of plastering baskets with clay. We may therefore hope that Mr. Meek will secure details and photographs of the process before it passes out of reach.

There is much that is of interest in the accounts of social organization, government, law, and religion, though there are indications that in some directions the author's vision was not as clear as his intentions were praiseworthy. His account of totemism, for example, is lacking in definition, and his use of the term " animistic tribes " for those whom he also at times calls " pagan tribes " is not to be commended, since it stretches the term " animism " beyond the limits of elasticity. Of the customs of ceremonial king-killing, of rain-making, and of other equally interesting matters there is no space to speak. We may hope that Mr. Meek will find it possible, in spite of the claims of other official duties, to concentrate on a more limited field of investigation, now that he has done so much to show how much there is to do.

H. S. H.

Vagandi Mos: Reiseskizzen eines Botanikers.— Dr. Herman Knoche. I. Die Kanarischen Inseln. Strasbourg: Librairie Istra. 1923. 10 × 6½, pp. 304. *Illustrations.*

Though the Canary Islands have been well served by botanists, there would appear still to be room for Dr. Knoche's comprehensive work, the result of a

sojourn in the islands from December 1915 to June 1916. During this period he visited them all, though the greater part of his time was spent on Teneriffe. He was, of course, concerned most with their botanical and ecological aspect, but the special value of his book lies in his continued emphasis of the geographical factors underlying the distribution of the vegetation. These partially submerged volcanoes are inhospitable alike to plants and to man, and the predominating lavas are only rendered productive through the influence of the Gulf Stream and the moisture-ladened north-easterlies. Rainfall is slight, and much of the vegetation on the higher slopes depends upon the moisture that can be extracted from the clouds. Within the general conditions thus imposed, there are many local variations, since, as the author demonstrates, the smallest change in topography is reflected in climate and vegetation. He regards the two greatest factors which have affected the vegetation as being deforestation and the propagation of *Opuntia* for the cochineal industry. The laurel woods "in the clouds" have suffered most by the former, as they occupied the area which now mainly supports the population, and where Mediterranean products are raised. Goats are also responsible for much damage. On the higher areas the *Pinus canariensis*, however, flourishes. On the borderlands of the lower and drier areas this destruction has been accompanied by erosion, and by an invasion of the desert plant associations. The cochineal industry, which had nearly died out, received an impetus from the war, and some of the best areas were then devoted to the growing of *Opuntia*. The book contains detailed chapters on each island, full botanical lists and distributional sketch-maps, and is also very thoroughly illustrated. With the addition of travel notes, it really gives a more complete picture of the islands than might be expected from the title.

AMERICA

The New England–Acadian Shoreline. (Studies of American Physiography.)—**D. W. Johnson,** Professor of Physiography in Columbia University. New York: John Wiley & Sons; London: Chapman & Hall. 1925. 6 × 8, pp. xx. + 608. 273 *Figures*. *Cloth* $8.50 (42*s*. 6*d*. *net*). (Awarded A. Cressy Morrison Prize of the New York Academy of Sciences for 1924.)

A few years ago Prof. Johnson published a treatise on 'Shore Processes and Shoreline Development.' The present work is a companion volume dealing with the shore phenomena of a particular area. A third volume is promised, and is to be devoted to a discussion of the coastal plain shoreline. The evidence for and against relative changes of the levels of land and sea will form the main theme.

The present work is primarily a very detailed application to the Acadian shoreline of the general principles enunciated in the earlier volume. The treatment is exhaustive and thorough, but the great amount of detail is rather confusing to any one not intimately acquainted with the region. Nevertheless to the student of shore forms the volume is full of useful and interesting information and should be read with care.

A great deal has been written on Coastal Physiography, but the subject is still rather vague. Students are greatly indebted to Prof. Johnson for collecting together so much detail in his books and presenting it in an orderly, scientific manner. Only those who have studied shore phenomena in the field realize how complex are the relations of the several agencies to which they are due. Too often the *prima facie* explanation of a particular feature is assumed to be

correct. If the author had succeeded in nothing else than exposing the fallacy of this assumption he would have achieved much.

The present volume is divided into two parts. The first deals with the initial form of the New England–Acadian shoreline, the second with the subsequent alterations. The earlier part is a general treatment of the relation of coast-form to tectonics. It is illustrated by some good maps, and shows very clearly how far dynamical geology has controlled the main trends of the shoreline. The arguments and the criticisms of other work are sound—especially with regard to the theories based on fractures in approximate alignment.

The second part is devoted to the detailed study of shore phenomena on coasts of various types. Erosional forms, wave-built forms, and submarine forms are discussed fully in their relations to shores formed by (1) resistant uplands, (2) weak rock lowlands, and (3) unconsolidated deposits. This arrangement makes the reading a little fatiguing, but it is difficult to see how it could well be improved upon. Of especial interest are the studies based on the off-shore profiles of the several coastal types—a subject which has not previously received the attention it deserves. From a study of these profiles the conclusion is reached that the Acadian shoreline is in a very youthful stage of development, and the author goes on to say that " . . . some observers credit to marine agencies an amount of erosive work which would seem to require a long time for its accomplishment ; but the discrepancy is largely accounted for when we take into consideration the effects upon the rate of marine erosion produced by variations in the initial shore profile and in rock structure and resistance, and more especially when we recognize that partial submergence of sub-aerial forms frequently produces a fictitious appearance of extended wave cutting. Thus the rocky cliffs . . . [etc.], all seemingly attributable to extended erosion of the lands by the sea, are found to be reasonably interpreted as the result of limited modification by marine agencies of forms earlier produced above sea-level by sub-aerial forces, and only recently brought within reach of the waves " (pp. 233, 234).

The final chapters deal with the rôle of tides and the effect of shore-ice in shoreline development, and also with tidal marshes.

The book is admirably illustrated with maps, block diagrams, and photographs. It is unfortunate that it is printed on such highly glazed and loaded paper, which renders it very awkward to read. The advance summaries and *résumés* at the beginning and end of each chapter are a trifle tedious. The bibliography is very complete and useful. It is to be regretted that a general map of the whole area—preferably geological—on a fairly large scale is not given : it is not easy to locate many of the places mentioned. But apart from these few minor defects we congratulate the author on a work of great value to the student of shore-forms and we anticipate with pleasure the appearance of the next volume. J. A. S.

Sketches of Eighteenth-Century America; more " Letters from an American Farmer."— St. John de Crèvecoeur. Edited by H. L. Bourdin, R. H. Gabriel, and S. T. Williams. New Haven : Yale University Press. London : H. Milford. 1925. 9 × 6, pp. 342. *Portrait.* 18*s. net.*

Crèvecoeur was an interesting minor figure in North American history in the latter half of the eighteenth century. He began his career by fighting in the French forces under Montcalm, and then moved into New England, where he supported the English authorities against the colonists. Eventually he became a French Consul in the United States, and ended his days as an *emigré*

in Hamburg. He thus viewed events in New England from an individual and fresh point of view. On arriving there, he took up farming for some years, and interested himself keenly in agricultural problems. His opinions were first published as "Letters from an American farmer" in London in 1781. The present collection contains many which had remained unnoticed until very recently. Written in the rather flowery, moralizing style of the late eighteenth century, they are at times slightly heavy reading, but they deserve study for the picture they give of the trials confronting a pioneer, and the lack of interest taken by the great majority of Englishmen in the condition of the colonies. Crèvecoeur complains of the Indians, of wild animals, of plagues of insects, of the severe winters, and of the lack of capital and skilled labour. Though a loyalist himself, he states the case against the exactions of the "nabob" merchants of London, and against high taxation. His sketches also show to what extent agrarian discontent contributed to the outbreak. His accounts of combined Indian and loyalist raids, as well as his characterization of the "radical" party, prove that he was alive to the faults of both sides.

Memoirs of a Lifetime in the Pike's Peak Region.— **Irving Howbert.** New York and London: G. P. Putnam's Sons. 1925. 8 × 5½, pp. vi. + 298. *Illustrations.* 10*s.* 6*d. net.*

The striking and rapid changes which Colorado has undergone in the last sixty years are well brought out in this book. As a boy, Mr. Howbert was one of the 60,000 people who, attracted by the reports of gold, streamed across the plains to the Rocky Mountains in the summer of 1860. On the ebb of the gold rush, he made his home near Colorado Springs. With the initiation of irrigation projects, agriculture on a profitable scale became possible, though in the first few years the settlers had many obstacles to overcome. The summer of 1863 was very dry: the following winter was marked by heavy snowfalls, so that in the next year they were afflicted with floods, and in addition heavy rains and swarms of grasshoppers. They were also faced with the problems of an unorganized and rapidly growing community, and had to take their own measures to protect life and property. But for a year or two the greatest menace came from the Indians, a menace not removed until after a good deal of bloodshed, and the transfer of the Indians to reserves. The author gives his own service experiences, and warmly defends the justice of the Indian wars. Not for long did he continue as a farmer. The remaining chapters deal with the business and political life of the State, in both of which Mr. Howbert came to exercise considerable influence as banker, railway and mining director, and State Senator.

The Argentina of To-day.— **L. E. Elliott.** London: Hurst & Blackett. 1926. 9½ × 6, pp. xii. + 284. *Sketch-map, Portrait, and Illustrations.* 18*s. net.*

Visiting Argentina prior to the Prince of Wales' visit as special correspondent of the London *Times*, the writer was fortunate in that her pathway was smoothed by the courtesy of the British railways in that country as well as by the experience of influential members of the British colony. To these advantages and to her official introductions, Miss Elliott added a trained observation already familiar with Latin-America. The result is the present most readable book. The chief cities are visited in turn. Buenos Aires of course claims the most attention, and after it Cordoba, Mendoza, Mar del Plata (a melancholy sight in the "off-tourist" season); Bahia Blanca, which comes in

for an unexpected meed of praise; Tucuman in the north; and even far-off Jujuy and Posadas. Owing to the exigencies of time and distance, the writer appears to have left hospitable Pullman trains only to step into the ubiquitous Ford car, which with its kind has revolutionized the working of the Pampas in two short decades. So we visit in turn the irrigation districts on the Great Southern Railway in Patagonia; the hardwoods of the Chaco; the oil districts and vineyards of Mendoza province; yerba mate plantations and cattle ranches in Corrientes and Misiones. We are given in each region short historical *résumés*, which form an admirable background to the narrative of each excursion. This makes far better reading than the usual method of packing all the history of the country into a few indigestible chapters. Miss Elliott's thumb-nail sketch of General San Martin as "an opportunist, whose inept and dishonest actions later in Peru sufficiently displayed his quality . . .," is a trifle sweeping however, and will hardly appeal to Argentines as an adequate portrait of their national hero.

But let it pass. We have already done so by turning the page. Here from contemplation of the snow-clad Andes we flit to the dusty Pampa; from investigating the interior of a half-breed's hut we go to the gorgeous apartments reserved for the Prince and his suite in the "Palacio Basualdo," with its pink silk boudoirs "and, yes, gilded bath-taps." Following the writer on these successive excursions we consult in vain the sketch-map inside the book-cover for any guidance as to our whereabouts; especially so when to a list of minor railroad junctions is added much topographical detail. Free use of Spanish equivalents in naming the flora and fauna of Argentina will also make more appeal to those familiar with the country than to strangers. However, the want of a good map merely calls attention to gaps in our geography, and Spanish words save paraphrasing. We can at least be grateful for the studied absence of the word "Argentinians," new-coined by the English Press in 1925. It is never used by any one familiar with the country or its people, and appears reminiscent of the Balkans.

As a photographic, or rather kinematographic, presentment of Argentina, Miss Elliott's book most admirably fits its title. Her bad impressions of the Argentine climate must be due to some personal bad luck, for those who have lived in the country will not endorse them. Elsewhere she has a truer flair. The primary function of the Paraná river is not to give facilities for navigation, but to pile up silt in its fertile Delta. She notes, with other experts, the absence of large-scale pig breeding in a land overflowing with alfalfa and maize. And why does not young Argentina take to winter sport in the Andes? Why, indeed. Venturing further in speculation, we are asked, "Is Argentina retaining her human material (*i.e.* immigrants)"? "What is being made of this mass of folk?" "What will be the outcome of such a concentration (in Buenos Aires) of effort and blood?" In a word, "Quo vadis," Argentina? But having posed the query, Miss Elliott, in true journalistic fashion, leaves us to answer it ourselves, while she embarks again lightheartedly for London, carrying with her a little green "cotorrita," or Argentine paroquet, as a cherished souvenir.

Whether it is possible to get a really truthful impression of any South American country, with its many-sided physical, social, political, and business facets, from within the covers of one book, is an open question. At all events this is the latest and one of the best "omnibus" books of the many written on Argentina since the war. The illustrations, chiefly of "camp" scenes, etc., are adequate. 'Argentina To-day' should find readers on both sides of the

Atlantic, as well as on the three-weeks' voyage which separates us from River Plate shores. W. S. B.

Geology of the Republic of Haiti.— Wendell P. Woodwring and others. Official publication of the Department of Public Works, Republic of Haiti. Port-au-Prince. 1924. 9 × 6, pp. 632. *Maps and Illustrations.*

The ponderous volume under review records the exhaustive researches made by Mr. Woodwring and his colleagues in Haiti during the winter of 1920 and subsequently in the Washington Offices, and forms a companion volume to 'A Geological Reconnaissance of the Dominican Republic,' by Thomas Wayland Vaughan and others, published in 1921 (see review in *Journal*, vol. **61**, p. 380).

Haiti, like the rest of the West Indian islands, was, during late Mesozoic and Tertiary times, part of the equatorial syncline that apparently almost completely encircled the globe. The major tectonic features, which are arranged in arcs, resembling the arcs of the geographic features, trend northwestward, and are convex southward, though at the west end of the peninsula they seem to branch out in sheaf-like fashion. There were apparently three principal periods of folding, one at the end of Cretaceous, one at the end of Eocene, and, most important of all, that which took place in Miocene times.

The schistose limestones of Tortue Island and the metamorphosed schists found as float on the North Plain, are probably the earliest marine deposits in the Republic, and are presumably of Palæozoic or Early Mesozoic age, but the known Mesozoic history begins with a long-continued period of vulcanism in the northern part of the Republic. This was succeeded by a marine period of grits, argillites, and, in the upper part, of fossiliferous limestones which can be paralleled with the Upper Cretaceous Strata of St. Croix, Porto Rico, the Dominican Republic, Cuba, Jamaica and Europe. The intrusion of these sediments by igneous masses is interesting as affording a guide to the age of similar intrusive rocks in the British Virgin Islands, where no fossiliferous sediments are found. The Tertiary Period was characterized by grits, conglomerates, foraminiferal limestones, and interbedded volcanic rocks, the whole series occupying synclines and anticlines in the Central Plain and being differentiated by their fossil contents; of these latter, numerous lists are given, with plates of the new species described.

A considerable portion of the volume is devoted to the mineral deposits, which are of two types, the contact metamorphic deposits in limestones, and the fissure veins in the volcanic and intrusive rocks. Iron and copper, with small amounts of silver, gold, lead, and zinc, are among the chief metals present, but all of these are considered of doubtful workable value. The south-eastern part of the Central Plain is considered a promising ground for the search for oil. Other rocks of economic value, such as sand, lime, guano, salt, etc., receive attention, while a large part of the book is devoted to the water resources of the colony.

We cannot help feeling that in a volume purporting to deal with the geology of the Republic, a quite disproportionate amount of space (150 pages out of 630) has been allotted to the general economic geography and detailed geomorphology of the district.

A clearly printed coloured geological map of the whole country on the scale of 1/500,000 (rendered difficult to interpret owing to the complete absence of hachuring, contouring, and dip marks) and a detailed coloured map of the Terre Nuove region on the scale of 1/50,000 are added in a folder at the end,

while a large number of topographical and tectonic maps and a comprehensive index and bibliography complete the volume. K. W. E.

AUSTRALASIA AND PACIFIC ISLANDS

The Bright Islands: Tales and Legends of Hawaii.— Padraic Colum. New Haven: Yale University Press; London: H. Milford. 1925. 9½ × 6, pp. xiv. + 233. *Illustrations.* 11*s.* 6*d. net.*

These Hawaiian myths and traditions have been collected by Mr. Colum and edited for the use of children. They all give evidence of the long memories of the Polynesians, and of their imaginative powers, as also of the frequent intercourse between the islands of the archipelago. The later tales show traces of outside influence, which ultimately set a term to the legendizing era. A late tale gives a version of the life of Kamehameha, the "Napoleon of the Pacific," which shows the passing of the true inspiration. As a poet Mr. Colum has succeeded in infusing the necessary spirit into the translations.

POLAR REGIONS

Seven Log-books concerning the Arctic Voyages of Captain William Scoresby, Senior, of Whitby, England. Issued in facsimile by the Explorers' Club of New York, with an Introductory Brochure edited by F. S. Dellenbaugh. New York: The Explorers' Club. 1916–17. 16¼ × 10½, pp. 27, 191, 57, 32, 38, 34, 83, 61. *Charts and Illustrations.*

The Explorers' Club is to be congratulated on its enterprise in attempting facsimile reproductions of certain of William Scoresby's logbooks. William Scoresby Senior has been to a certain extent overshadowed by his famous son, and it is therefore pleasing to see this fine tribute from the Explorers' Club to the memory of one of the greatest and most successful of whale hunters. Each page of the manuscript has been photographed as it stood, and the whole put together in folios similar in size and external appearance to the originals. The reading is necessarily laborious, but in no other way would it have been possible to do full justice to the log-books, filled as they are with marginal drawings and additional notes and memoranda. Scoresby, for instance, followed the usual custom of drawing a whale's tail in the margin to emphasize each "fish" killed: these are inked in when the whale could be brought alongside and flensed, but left blank when the whale was lost. More ambitious sketches are also inserted when neighbouring ships were crushed by the pack-ice, or when the ice-saw was in use. Such features would, of course, have been lost had the log-books not been reproduced in facsimile.

A study of these folios is recommended to any one interested in whaling, whether of the old-time variety or of to-day. They bring out very strongly the extremely hard life which the whalers led, and also emphasize the ruthless way in which the Greenland whale was hunted to death. Over and over again whales were harpooned and lost, only to die; the large number of dead whales found floating is very striking. The whalers had rules amongst themselves when the right to a "fish" was in dispute, but no rule by which a mother and calf should be spared. The killing of sucking whales is markedly common. On one occasion it is noted that a mother pulled the harpoon out of the young one with her fin. It does not seem surprising, therefore, that the Greenland Whale was exterminated; one can only hope that the same ruthless methods will never be applied to the larger Rorquals in our own time. J. M. W.

GENERAL

West of the Pacific.— **Ellsworth Huntington.** New York and London: Charles Scribner's Sons. 1925. 9 × 6, pp. xvi. + 454. *Illustrations.* 21*s. net.*

This is a very readable book. The author has made a tour of the countries west of the Pacific—a month in Japan, a week in Korea, seven weeks in Australia, two in Java, and five along the Chinese coast—and with lively mind and lively style has recorded his observations and impressions. So extensive a field, with its variety of scene and persons, of incidents and problems, has given him abundant scope for his gifts of narrative and exposition, of which he has taken full advantage. And for a book of the kind, this is exceptionally interesting and stimulating. The author has had good opportunities, has seen a great deal, finds nothing of human concern uninteresting to him, sets down his impressions with freshness, and touches no subject without trying to take his reader below the surface. But he does not treat his problems too seriously, and he enlivens his speculations with telling illustrations and apt stories. It is not possible to follow him in his light and easy passage from problem to problem of the Orient and Australia. Nor does the final conclusion with which he sums up his impressions challenge discussion. But it may be set down in his own words: "As I look back over my journey west of the Pacific, I am conscious that the main addition to my own stock of ideas has been a new realization of the fundamental part played by temperament," in determining, as he explains, the status of a people. "In Japan the whole tone of the social organization is permeated by a gracious artistic temperament which endures all sorts of discomfort, and even resorts to all sorts of ruses, rather than destroy the beauty of nature or the beauty of social intercourse. In China the social structure is almost equally dominated by an economical, thrifty, and outspoken temperament which cares little for outward beauty, provided it protects itself and gets what it wants. In Java, again, a pleasure-loving, easy-going temperament . . . seems to be dominant. Finally, in Australia an optimistic, unconventional, energetic temperament is prevalent, and has gone far toward making the social organization of that country the most advanced in the world." This does not carry us far; and some of the author's theories and comments may appear far-fetched, and his historical background insufficient for interpreting many of the matters he discusses. But the book well repays reading. In engaging style it gives many a striking picture of life west of the Pacific, and the illustrations are attractive and instructive. E. A. B.

Philip's Senior School Atlas.— Edited by **George Philip.** London: George Philip & Son. 1926. 12 × 10½, 84 *maps*, 32 *pp. Index.* 10*s.* 6*d. net.*

This is a revised and enlarged edition of an atlas first published in 1920 to meet the increasing demands made by schools for an atlas of a more advanced character than those in general use for pupils preparing for examinations of matriculation standard. It is intended as a general atlas for students taking advanced courses in secondary schools, training colleges, and universities. It incorporates all the recommendations of a special committee appointed by the British Association to inquire into the whole question of atlases, textual and wall maps for the use of schools and geographical students, and neither money nor pains appear to have been spared in the effort to produce a really satisfactory atlas. The new edition has been considerably enlarged and several new features have been introduced, the chief of which are (*a*) a series of con-

tinental and other more detailed maps showing, by zones of colour, actual temperature; (*b*) more large-scale maps of important small areas; (*c*) more large-scale maps of important parts of the Empire. Unfortunately some of the new maps are insets and are drawn on too small a scale, *e.g.* the Geological Map of the British Isles.

Taking the atlas as a whole, it is a very creditable production. The printing, the colour schemes, the selection of data, and the general appearance of the maps are all very good. Whenever a new edition is prepared it is hoped that the policy of including more large-scale maps of selected areas will be generously extended, especially if the price remains at 10*s.* 6*d.*, which is perhaps somewhat high, at least for schools. L. B.

Far Harbors around the World.— Hubbard Hutchinson. New York and London: G. P. Putnam's Sons. 1924. 9 × 6, pp. xv. + 324. *Fifty-four Illustrations.* 15*s. net.*

One thing the author of this travel book unfortunately lacked. On page after page, with profound solemnity, he describes with almost painful detail the trip of a party of Americans on a world tour: how they spent the one or two days allotted in the time-table to each "far harbor," what they were able to see, and especially what they bought there. It began with flowers and chairs at Madeira; cheap champagne, for some, at Algiers, and so on to malacca canes at Singapore and grass baskets at Guam. In place of that badly needed saving sense of humour, the text is occasionally relieved by phrases such as "Beside it our negative Sabbaths plucked anæmic harpstrings," or "Picture a child of Othello and Ninon de l'Enclos, and you have the modern Algiers." However, the conscientiousness of the author will doubtless be appreciated by those who, having made a similar trip, may desire a permanent record. In fairness it must be admitted that he is aware of the limitations imposed upon such travellers, of "the rather painful ramparts dividing observers from observed." There is one entertaining anecdote: the definition of neutral ground by a sergeant at Gibraltar—"It don't belong to no one except in time of war—then it belongs to us."

THE MONTHLY RECORD

THE SOCIETY

Medals and Awards, 1926.

HIS Majesty the King has approved the following awards: The *Founder's Medal* to Lieut.-Col. E. F. Norton, D.S.O., M.C., R.A., for his distinguished leadership of the Mount Everest Expedition, 1924, and his ascent to 28,100 feet; the *Patron's Medal* to Professor Sir Edgeworth David, K.B.E., C.M.G., D.S.O., F.R.S., for his work on the Funafuti atoll, and with Sir Ernest Shackleton's Antarctic Expedition of 1907–09, as leader of the first ascent of Mount Erebus and of the party which first visited the South Magnetic Pole. The Council have awarded the *Victoria Medal* to Dr. John Ball for his Desert Surveys and Memoirs on the Geography of Egypt; the *Murchison Grant* to Mr. Frank Debenham for his contributions to the scientific exploration of the Antarctic; the *Back Grant* to Afraz Gul for his surveys in Central Asia and Hunza; the *Cuthbert Peek Grant* to Major Kenneth Mason to assist his further exploration of the Himalaya; the *Gill Memorial* to Dr. H. Gordon Thompson for his journey on the Tibetan and Mongolian Borders of China with Brig. General George Pereira.

EUROPE

East Anglian Geography.

Two articles of geographical interest appear in the first number of a new serial called the *Journal of the Ipswich and District Natural History Society*, which has been sent to us in accordance with the resolution passed last year at the Southampton Meeting of the British Association urging all corresponding societies to present copies of papers published by them to such bodies as prepare bibliographies of particular subjects. The first, by Prof. P. G. H. Boswell, is an attempt to reconstruct the physical history of the East Anglian River Stour by a study of the surface topography and geological structure of its basin. The remarkable regularity of the Stour and its tributaries, always in directions closely approximating to E.N.E. and S.S.E., is held to be no mere coincidence, but to be definitely related to the strike and dip of the "solid" geological strata (chalk and Eocene) and to bear witness to river-capture in the past, the Colne, amongst others, having probably been beheaded. Of the more recent formations, both the glacial sand and gravel and the boulder clay which overlies them, are not confined to the upper levels, but extend down into the valley. In particular the boulder clay transgresses the outcrops of the glacial sand, Crag, and Eocene deposits in the valley, resting at all levels, even upon the chalk, low down in transverse and longitudinal portions alike. This clearly disproves the view that the valley is post-glacial in age. It was graded and fairly mature before the Glacial period, and there are indications that one of the many meanders (near Sudbury) was subsequently cut off by glacial streams, the old river-bed being left as an ox-bow lake. As the ice retreated the river first deposited its high-level terraces of coarse gravel and sand, and then the bedded brick-earths and alluvium. A post-glacial subsidence of 60–80 feet turned the lower portion of the valley into a broad tidal estuary, the mouth of which has since been diverted southwards by the tidal drift which piled up the banks of shingle forming Landguard Point.

The second geographical paper, by Major E. R. Cooper, treats of the Suffolk coast in some detail, showing the losses to which it has been subject through the action of tides and storms, and the various historical events with which it has been associated.

Smoke and Vegetation in England.

The evil effects on the public health not only of the more acute phases of smoke-fog, but of the more constant smoke-pall which diminishes and vitiates the sunlight, are now sufficiently recognized, but the widespread effects of smoke on vegetation are not so generally understood. Attention may therefore be called to a recent pamphlet by Mr. R. W. Ascroft, late of the Food Control Department of the Board of Agriculture on "The Conservation of the Nation's Vegetation. The Effect of Smoke on Plant Life" (London: Knapp, Dremett & Sons, Ltd.). The facts examined are largely based on scientific researches, including those of Dr. J. S. Owens (Secretary to the Advisory Committee on Atmospheric Pollution), and prove the damage which is being done to gardens and crops, as well as historic public buildings, not merely in the immediate vicinity of the great towns, but in many country districts also. Smoke has been shown capable of drifting in quite a concentrated stream 50 miles from the centre producing it. It not only reduces the vitality of plants by cutting off sunlight, but also, through its content of sulphurous oxide, which is ultimately washed into the soil by rain, causes an injurious degree of acidity and reduces the feeding value of grass in the industrial districts of England. There

are also oily and tarry hydrocarbons present in coal smoke, and these make the soot cling more tenaciously to the leaves of plants, choking their stomata, than would otherwise be the case, particularly after dense water fogs. The trouble which London's smoke has always been at Kew Gardens is indicated, among other details, by the removal of a collection of conifers to the neighbourhood of Tunbridge Wells. Market gardeners, again, have difficulty in raising the proper quality of produce near large towns, and suffer considerable loss in having to grow vegetables far away in the country. In the heart of smoky Leeds, it has been found that laurels, and other evergreens, actually become deciduous. Mr. Ascroft finally urges all classes of citizens, but especially horticulturists and agriculturists, to spare no efforts in arousing widespread public interest in the measures being planned by Government for smoke abatement.

It is surely something of a tragedy that the fresh verdure naturally favoured by the coolness and moisture of the English climate should even now be seen at its best only in the parts more or less out of reach of smoke drift. But the poisoned oaks and pastures seen amid the slag heaps of the Black Country are but extreme examples of conditions prevailing in milder form over much wider areas in the Midlands. In and around London, even, though far from the smokiest of great cities, the true colour of a tree-trunk is rarely seen, and leaves shrivel up and drop off, species for species, about a month earlier than in the surrounding country.

The Iron Industry of Normandy.

An article under this title by Mr. H. V. Janau appeared in the *Scottish Geographical Magazine*, **41**, 1925, pp. 266–84. After the Lorraine mines, the chief iron deposits in France are in the departments of Calvados and Orne, Normandy, though their output is small by comparison. The superficial deposits were worked from pre-Roman times, and the consequent demand for fuel led to the deforestation of large areas. Down to the eighteenth century the industry was largely seasonal, depending upon variable supplies of water for the "hauts fourneaux," and of labour. When in 1786 the import duties on British iron were removed several forges closed down, and competition proved too strong throughout most of the following century. In 1875, however, geological investigations revealed valuable deposits of ore at May, and later at Halouze and La Ferrière-aux-Etangs. The iron-bearing sandstone is found in several bands running roughly east and west across the Armorican massif. These bands are the remnants of Silurian synclines which have been preserved embedded in older rocks. The presence of iron ore in the sandstone is attributed to the existence of a later covering of Jurassic rocks: water containing salts of iron filtered through the limestone and converted the carbonate of lime into carbonate of iron. This impregnated the sandstone. When the Jurassic cover was denuded, the carbonate exposed to the atmosphere was oxidized to hematite, so that hematite is now found in the upper, and carbonate in the lower, levels. The north–south drainage system across the grain of the older rocks was due to the same cover: when it was removed the rivers maintained their courses, and developed lateral streams along the old Cambrian valleys. The present river system therefore gives access to a difficult area, and where the streams cut the sandstone bands the ore can be reached by horizontal adits. Thus the Caen–Laval railway, by which the greater part of the traffic is carried, crosses the area by ascending the valleys of the Orne and Noireau and descending the Varenne and Mayenne. The roads and

villages on the other hand keep to the plateau, at a considerable distance from the stations. This typifies the general attitude of the region towards the mines, for the conservative peasant has remained an agriculturist, and labour has had to be imported from Spain, Italy, Greece, Poland, and North Africa. Similarly, until German capitalists became interested in the deposits, little was achieved. By 1914, out of twenty mining concessions, eleven were under German control or management. The war, with the disorganization of the Lorraine mines, gave an impetus to French interest in the Norman area. The output of ore had been raised to 800,000 tons in 1913. Of this about 76,000 tons went to England, 67,000 tons to Germany, and 262,000 tons to Rotterdam, chiefly for Ruhrort, the chief port of export being Caen. The methods of handling the ore there are primitive, so that on an average it requires six days to load a vessel of 2000 tons. In return for the ore, coal is received, 80 per cent. of which came in 1913 from Great Britain. The boats running to Rotterdam would unload there into lighters, and cross to Newcastle for their return cargo. The bulk of this coal was used for domestic purposes.

The main obstacle to development is the distance of Normandy from the great coalfields. South Wales is 480 miles away by sea, and the coalfields of Northern France 200 miles by rail. Thus little smelting has been done so far. In 1912, however, blast furnaces and steel works were begun at Colombelles, near Caen. Stimulated by the war, the production of pig-iron had risen to 54,000 tons in 1920. The programme contemplates industrial developments which would require 1,500,000 tons of coal annually. All this must be imported, and no adequate return cargo is forthcoming. This, and the labour difficulties mentioned, lead Mr. Janau to conclude that under present conditions the Norman iron industry cannot compete with that of Lorraine or Germany.

Hannibal's Pass.

Signor Montanari, the lifelong student of classical campaigns, whose theory as to the route by which Hannibal crossed the Alps was noticed in our February number, has kindly presented to the Society's Library a number of the tracts and articles he has printed on this and cognate questions. He writes: "Those who wish to examine my theory should read by preference my *Précis de l'itinéraire d'Hannibal* and my *Miraggio e realta*, and the MS. memoir I send with my pamphlets. I have abandoned the view expressed in my large volume of 1900–1, and am convinced that the problem is solved in favour of the Col des Échelles." We regret that we are unable to print in full S. Montanari's Memoir, which confirms and fills in details of the route he now supports, as it was set out in our Review.

ASIA

Volcanic Island in the China Sea.

In the *Journal* for July 1923 we gave some account of two volcanic islands that had lately appeared in the China Sea as observed by the captain of the Japanese S.S. *Wakasa-Maru* on April 2 of that year, and by Capt. Dickens, R.N., of H.M.S. *Carlisle*, on March 8. Some additional observations, made early in May by H.M. Survey Ship *Iroquois*, were also given in the August number (p. 153). Lying so near the coast of Annam, it was natural that the phenomenon should attract attention there, and on various occasions French parties landed on the principal island and made careful observations of its form and structure. Combining the results of these observations with those recorded in the *Journal*, M. Etienne Patté gives a coordinated account of the

brief history of the island (which had disappeared before the end of July, 1923), well illustrated by sketch-maps and photographs (*Bull. du Serv. Géol. Indochine*, vol. **12**, fasc. ii., Hanoi, 1925). The first French visitors were members of a hydrographical party on the *Astrolabe*, who were there on March 15–17 and made a map of the island. It was still in a state of activity and a thick and black column was discharged to a height of 100 metres. The outline was then crescent-shaped, and it was easy to see that the island was a volcanic cone with anticlinal strata, of which the portion to the N.N.E. had been destroyed. On this side it had probably been less developed owing to the action of the north-east monsoon, and had possibly never formed a complete ring. In company with Commandant Dussault, M. Patté landed on the island on April 5, when the eruptions had ceased and the island had been greatly reduced in size, now taking the shape of a bean, the horns of the crescent having disappeared. Renewed activity was reported on and after April 20, and was still maintained at the time of the visit of the *Iroquois*. On May 27 the French observers returned and found that the cliffs bounding the central part had retreated considerably, and were surrounded by a flat beach on which it would have been possible to make the complete circuit of the island. The natural section afforded by the cliff showed the succession of strata very clearly, particularly as they were emphasized by deposits of salt. On the outer side they sloped at an angle of about 20°, but on the inner they were less regular, and discordant with the others. The *ejecta* consisted chiefly of basaltic pumice of variable size with smaller fragments of vitreous lava and minute fragments of glass and crystals. Fragments of older basalt and limestone led to the conclusion that the new volcano occupied the site of an old centre of eruption, or at least lay in a volcanic region. The gas discharged from the submarine vents was inodorous, but on walking on the scoriæ a sulphurous smell was noticed, and birds had been asphyxiated on alighting on the surface. The eruption appears to have been of the Strombolian type modified by its situation in the sea. From a consideration of other evidences of volcanic action in the surrounding regions M. Patté thinks that we have here the renewal of a former activity contemporaneous with the Quaternary volcanoes of the Massif Central of France. The name adopted by the French for this ephemeral island is *Ile des Cendres*.

AFRICA

Sudan Surveys in 1925.

The outstanding feature in the report of the Sudan Survey Department for 1925 is the introduction in Khartoum of an electrically driven flat-bed printing machine, worked in conjunction with the Douglagraph process of printing from zinc plates. This innovation, in the words of Mr. Boyce, "enables us to reproduce maps in colour and to print in one day what would take a week on the old hand-presses." Already the issue of map-sheets is more than three times what it was in 1923, and there can be little doubt that, as map-users learn the ease with which their demands can be met, the employment of maps for all purposes will still further increase, to the great benefit of the country. Another modern development is the successful use of wireless longitudes and latitudes to control a compass and wheel traverse for topographical work in the almost featureless but thickly wooded districts of the Bahr el Ghazal Province. In other areas the topographical maps have been improved by a satisfactorily large number of route and similar surveys supplied by officers and officials.

Mr. Boyce has also taken in hand the much-needed work of recomputing and adjusting some of the scattered stretches of triangulation which exist in

different parts of the Sudan, and in particular the old triangulation in the Kassala and Red Sea Provinces has been adjusted to agree with that on the Egyptian side of the frontier. This most valuable and necessary revision is doubtless only the first step towards the gradual tying up of all these various isolated chains and the supplementing of them by such additional triangulation as is required to form a consistent framework on which really accurate maps can be based, whenever and wherever such maps become requisite.

As is to be expected, a large part of the time of the Department has been occupied by the cadastral mapping required for the recently initiated Gezira Irrigation Scheme, and all the demarcations and readjustments of boundaries which have been occasioned by it. The Director of Surveys concludes his report with a note in which he emphasizes the great need of better and more complete training for the Sudanese surveyors. While the results of his examinations, with less than 10 per cent. of passes, show how much still remains to be done, he is much to be congratulated on his determination to hold a training school in the Red Sea Hills during the summer, where surveyors may obtain practice in various methods of survey outside the immediate work in hand. The crying need for maps in the earlier stages of the organization of a Survey Department has resulted, certainly in both Egypt and the Sudan and probably too in the other countries of the Near East, in the production of a native staff trained to one job only and doing it well, but owing to press of work entirely without experience of other survey methods. As Mr. Boyce most truly says, "It is, I consider, a waste of Government money to pay a man more than £12 per month who has nothing but a superficial knowledge of plane-table work and is quite incompetent to do any other class of survey."

G. S. L. C.

Saint-Louis, Senegal.

A comprehensive study of Saint-Louis and its future prospects, by Mons. R. Rousseau, has appeared in recent numbers of *La Géographie* (Juillet-Août 1925 *et seq.*). The main thesis is its gradual decline in importance. Its site on an island several kilometres up from the mouth of the Senegal river had several advantages in 1659 and even later; but the necessity for a defensive position has passed, and the increase in the size of shipping makes the negotiation of the river bars difficult, and impossible altogether at certain seasons. Its climate is favourable, the long dry season and proximity to the sea causing it to be the least trying in Senegal. Originally it was merely a fort and trading post, so that its population grew slowly. In time however a large number of Negroes were attracted, and in 1835 the total population consisted of 130 whites (including the garrison), 750 "gens du pays," and 10,000 Negroes. With the advent of Faidherbe as Governor in 1854, Saint Louis's period of prosperity opened. It was the base of operations for the reduction of the interior, and the seat of government of a considerable territory. Faidherbe also did much to improve the town by securing better drinking-water supplies and better sanitary conditions, as also by protecting it from floods, building bridges, and extending harbour facilities. In 1885 the St. Louis–Dakar railway was opened, and though this was later to operate against St. Louis's position, its immediate effects were beneficial. At the end of the nineteenth century, therefore, St. Louis was at the height of its prosperity. Its subsequent decline is largely due to two interacting causes: its own economic position, and the competition of Dakar. Each trade artery starting from St. Louis has some measure of disadvantage: the land route through Khor Rosso and Podor largely follows the Senegal, and is liable to floods: lacking also any efficient

means of transport it is practically useless. The rôle of the railway as regards St. Louis is to carry merchandise from Dakar for distribution in the surrounding region and in Mauritania ; while by carrying off the ground-nut products of the area it traverses it robs St. Louis of a profitable hinterland. The Senegal remains the great route to the interior, yet it is only navigable when in flood. In good years boats drawing 5 metres can reach Kayes, 925 km. upstream ; but this is exceptional, and at low water navigation is confined, except for very small boats, to the estuary. Further, the presence of constantly shifting sand-banks at the mouth of the Senegal makes it difficult for large vessels to enter the port. From November to April, a vessel may have to lie outside for a week awaiting an opportunity to enter. St. Louis has no local industries of importance : it is purely an *entrepôt*, depending upon its hinterland. The great development of Dakar has deprived it of this. With a fine harbour, a better position on the ocean routes, a rich region lying behind, and good railway communications, Dakar has far outdistanced St. Louis. The latter has no permanent link with Kayes, on the upper Senegal, while the opening of the Kayes–Dakar line is diverting the traffic to that port. Thus, under government favour, Dakar is becoming the port of entry for Senegal and French West Africa in general.

AMERICA.

Stream Meanders on the Colorado Plateau.

The first number for 1926 of the Chicago *Journal of Geology* contains an elaborate discussion by Mr. Raymond C. Moore of the origin of " enclosed " meanders on streams of the Colorado plateau. As is well known, both the Colorado itself and other rivers of this region are remarkable for the depth to which they have excavated their canyons, and the winding nature of parts of their courses is another noteworthy feature. By " enclosed " meanders the writer understands generally such as are more or less closely bordered or enclosed by steep walls, thus including both the " incised " and " intrenched " meanders of W. M. Davis, who distinguished between those developed by lateral corrosion on streams that originally had only slight irregularities in their courses (incised) and those formed by rejuvenation and dominant downward corrasion only (intrenched). An examination of the river-courses on the accurate topographic maps recently made available shows that the most pronounced meanders are restricted to certain parts of the streams. Thus while the Colorado is constantly swinging to right and left above the mouth of the Green and in Glen Canyon, meanders are poorly developed in Cataract Canyon, and similar differences are to be noted on the San Juan, Fremont, and Escalante. (The writer measures the tendency to meander in different portions by calculating the ratio borne by the length of the actual course to the median line of the meander belt.) In the case of the smaller streams he finds a distinct relation between excessive winding and the hardness of the rocks through which the canyons are cut, but on the larger streams such a correlation is not apparent. On the Colorado itself and also on the San Juan the walls of the meandering sections are for the most part very steep both on the convex and concave side of the curves, and there is but slight indication of lateral shifting. On smaller streams the spurs which project into the bends display well-developed slip-off slopes, showing that lateral as well as downward cutting has been at work. The conclusion is that the meanders of the larger streams are inherited from a course which antedates the entrenchment, but that the others have originated during the present cycle of erosion. In discussing the origin of enclosed

meanders in general the writer thinks that the distinction between "incised" and "intrenched" meanders cannot be sharply drawn.

POLAR REGIONS

Early Settlements in Greenland.

A Danish archæological expedition has recently been examining the ruins of Icelandic settlements in South and West Greenland, and Dr. P. Nörlund has contributed a very full account of the results to *Meddelelser om Grønland*, vol. 67. (A long *résumé* of this publication is given by William Hovgaard in the *Geographical Review* for October 1925.) This work has thrown much light upon the fate of the Norse colonists. At the settlement of Herjolfsnes, west of Cape Farewell, the site of a church built about the year 1300 was excavated, and, though part is now under the sea, evidence of 110 separate burials was found in the cemetery. Shrouds and costumes of woven material were found associated, also spinning and weaving implements. None of these costumes displayed a single Greenlandic feature, but resembled European fashions of the fourteenth and early fifteenth centuries. Fragments of Rhenish stoneware and other finds showed that communication with Europe must have been maintained throughout the latter century, that is, for a hundred years longer than was previously allowed. The interest of the finds lies particularly in the evidence they afford as to the fate of the settlers. From the human remains it is apparent that the later generations were very short of stature, and that there was a high death rate, especially among children. This, with the fact that the teeth show likelihood of tough vegetable foods, such as lichens, leaves, and barks, points to chronic under-nourishment.

On their first arrival the Norsemen had kept cattle and raised grain, both of which activities are now impossible through the severity of the climate. A change for the worse in the climatic conditions is further borne out by the fact that these deeply buried coffins were found entwined with the roots of plants, although they are now in perpetually frozen soil. Dr. Nörlund also believes that the southward advance of the Eskimo from the thirteenth to the fifteenth century was connected with the increase of drift ice along the coast, which brought the Eskimo source of food, the seals, southward too. There is no evidence at Herjolfsnes for the intermingling of the two races, so that it is probable that here the Norse settlers died out through inability to adapt themselves to the altered conditions. In the larger settlements it is possible that the Norsemen survived longer, and may even have mixed with the Eskimo. Dr. Nörlund's paper gives a very full account of the expedition and of the finds, and the volume also contains interpretations of the Runic inscriptions by Dr. F. Jonsson, and an essay on the medical and anthropological aspects by Dr. F. C. C. Hansen.

CORRESPONDENCE

The Eskimo of the Canadian Arctic: an Ex-trader's Views

". . . twenty new Posts (have been) established in the past fifteen years in the Eskimo country; each post represents a link in a chain (of posts) which will eventually become a chain of security for the Eskimo in every part of the Arctic. . . ."

The above is quoted from the brief speech of Mr. C. V. Sale, when congratulating Dr. Knud Rasmussen at the November meeting of the Royal

Geographical Society. That Mr. Sale spoke what he believed to be the truth I have not the slightest doubt, and it is unreasonable to expect the Governor of the Hudson's Bay Co. resident in London to know or understand more about the Eskimo and their difficult problem than the most experienced officers of the Hudson's Bay Co. tell him; and their view-point can hardly be other than fur returns from new posts established or contemplated.

The views of those of us, not connected with the great Company, who have traded and lived amongst the Eskimo and studied their mode of life and the conditions under which they lived both before and after "civilization" reached them is, I submit, entitled to a hearing. Believing, as I do, that the "chain of posts" outlined in Mr. Sale's sympathetic speech can never accomplish more for the Eskimo of the Western Arctic than to enslave him economically and eventually exterminate him, I will first indicate the conditions on the east side of Hudson Bay and the southern side of Hudson Strait in support of this statement.

Along the vast and dreary littoral between James Bay and Port Burwell at the east end of Hudson Strait, trading establishments have been conducted at some posts for over a century. If the theory of a "chain of posts" ameliorating the condition of the Eskimo's existence will bear examination we have every chance of proving it here. Unfortunately, it is an incontrovertible fact that along the coast-line named the native population is rapidly decreasing. Last year the Rev. G. Walton, for many years Church of England missionary at Fort George (north of James Bay), stated publicly in Canada that there had been many cases of deaths from starvation known to him during his mission work, and he drew a moving picture of the Eskimo's poverty. He did not suggest such starvation occurred actually at the Hudson's Bay Co. or Revillon Freres' Posts, though the latter company thought it necessary to deny such a construction, in a letter to the Montreal papers. The point I would emphasize is that this coast-line may be fairly described as possessing a chain of Trading Posts operated by the great companies referred to. I will enumerate some of them. East Main River, Fort George, Great Whale River, Richmond Gulf, Port Harrison, Cape Wolstenholme, Wakenham Bay, Fort Chimo, and Fort Burwell are the principal posts, with several small subsidiary outposts dependent on them. Why, then, one asks, with this long-established chain of posts, should the population be rapidly decreasing and, according to Mr. Walton, cases of death from starvation may occur there? Perhaps the following indicates cause and effect.

It was my ill fortune to have to spend six weeks at Port Burwell in the summer of 1922. Although there were two trading concerns there, namely the very altruistic Moravian Mission and the Hudson's Bay Co., I had not, in ten years' experience farther north, seen Eskimo living in such poverty and squalor as were the few native families who were camped near the post, and *who were not employés of one or the other company*. The run of codfish along this part of the coast had not yet commenced, seals were very scarce, and the ill-clothed and filthily dirty natives were subsisting mainly on unhealthy doughy bannocks baked in a frying-pan and sweetened with a little molasses.

I discussed with the young trader, and also the fine and sympathetic Moravian missionary, Pastor Lenz, the squalid condition, unhealthy appearance, and unnourishing food of these natives, and expressed my belief that these conditions had accelerated the death of one of them who was suffering from consumption. It was obvious neither the Mission nor the Hudson Bay Co. could start the precedent of free meals or unlimited credit to all natives coming

in to the post ; supplies would soon be depleted. The only course was to compel the natives to leave the post in search of food, for as long as rations were given, many of them would stay. " If the native loses his self-respect," said Pastor Lenz to me, " he rapidly degenerates ; we try to teach this virtue to him."

The question of debt is a constant worry to the trader. Where two traders are in competition, whether close together as at Port Burwell or a hundred miles or so apart—only three " sleeps " for the native with a good dog-team—debt is inevitable, and the native quickly learns he can obtain credit by a threat of transferring his business to a rival trader. Debt is equally hard to avoid where a trader has a monopoly, and it is a form of economic enslavement which reacts on the native character very quickly. When a native arrives at a trading post, perhaps from hunting-grounds 200 or 300 miles away, perhaps from the district near by, and the run of white fox has failed him, he must take back with him necessaries such as ammunition, powder, lead, a few cooking-utensils, and perhaps even a new rifle if his own is broken, for without one he will starve now he has forgotten the use of the bow and arrow. Yet he may only have a couple of white fox to trade. My own method was essentially unbusinesslike. I waited till the day the native was departing and I knew I should not see him again till the following winter ; I then gave as a gift essential things he needed, and hoped his catch the following season would average me up. I always paid natives in full for any fur bought, at my regular rates. They never were " in debt " at my posts.

It is worth recording that as a rule I found the native very honest ; as an example, I have given a native goods *to trade*, not seen him for two years, and received from him the fur he had traded for : on one occasion another trader collected this for me. But my trade methods would be impossible for a large company to adopt and would lead to hopeless confusion when the posts balanced their yearly accounts, which are most elaborately kept. So the system of debt prevails, and the Eskimo finds he is hopelessly enslaved and rarely free to trade where he likes ; he has lost his self-respect and independence ; in no long time he loses his honesty also.

I have had an opportunity of comparing the dirty, begging, ill-clad natives of Port Burwell—I except of course those in the employ of the Trading Companies—with the well-clothed, independent, cheerful natives of Hecla and Fury Straits, where the nearest trader is, or was, 400 miles distant, and the conclusion is inevitable : civilization as represented by trading posts and their demand for fox furs is ruination and enslavement to the free and nomadic Eskimo.

Chains of posts can never solve the problem of how to save the Eskimo. No trading company, however anxious to treat the natives with consideration, can afford to maintain their posts at a loss, nor to conduct their trading business as an eleemosynary concern for the benefit of the Eskimo. Instead of the " chains of security " so hopefully visualized by Mr. Sale, the posts become chains of bondage for the economic enslavement of the Eskimo.

In 1924 over 25,000 white fox-skins came out of the North-West Territories alone, according to the Government Report ; to this may be added about 7000 to 10,000 more from Labrador, Quebec, Ontario, and Manitoba. The average value of the white fox catch may be put at £250,000 for the Canadian Arctic. This is the explanation of the keen desire of the great trading companies' officials to establish " chains of posts," and of the attempts of smaller traders to get a share in this great Arctic fur harvest. It is the only business justification for such a venture.

I have said the existing chain of posts on the east side of Hudson Bay has been unable to save the Eskimo from occasional periods of starvation or to prevent their steady decline in population, and the same must inevitably happen in the unexploited region Mr. Sale so hopefully referred to in his brief speech. The same forces will be brought into operation there as have been at work for a century in Northern Quebec and on the Labrador, where the trading posts are accessible by sailing ship and steamer, and there is ample opportunity to fully supply them regularly each year. But the natives of the inaccessible region through which Dr. Rasmussen travelled will more swiftly succumb to civilization than those of Northern Quebec, for the deadly high-power rifle has already decimated the cariboo herds of the mainland there which supply the Eskimo with the only clothing in which he can fight the Arctic winter; no manufacture of civilization can take its place, and the transition to white men's clothing and farinaceous food will be too sudden for the meat-eating skin-clad native to get accustomed to.

I have heard traders urge the policy of increasing the demands of the native by inducing him to wear manufactured clothing in place of seal-skins, and to use flour, oatmeal, etc., till he got a desire for it; "the more demands the more fur" is the argument.

With the high-power rifle supplied by the trader, and at his instigation, the Eskimo now willingly leaves the sea-ice, where he has found seals for winter food from time immemorial, and hunts cariboo and successfully traps white foxes far in on the mainland. This is the first process of the natives' "economic enslavement to the great world to the south of him," to quote Mr. Diamond Jenness' pregnant phrase.

The Eskimo of Hudson's Bay and the eastern littoral are doomed; civilization has them in its relentless grasp. Not so, however, the freer and as yet but little exploited Eskimo whose habitat ranges from Hecla and Fury Strait west along the littoral of the Northern Continent to the Coppermine river. On behalf of these and of the natives of the islands lying north of the continent the Canadian Government have been urged to take action.

Reports from Royal Canadian Mounted Police officers along the northern shores of the continent have stated the cariboo herds are diminishing at an alarming rate. The above is the explanation.

Unless a drastic change is effected in the relations at present existing between the trading companies and the Eskimo of the Canadian Arctic, it is my considered opinion that the next fifty, or at most one hundred, years will see these people wiped out of existence, just as they are to-day on the southern coast of Labrador, where in 1800 they were a numerous and powerful race as far as the eastern end of Belle Isle Straits.

The following proposal was laid before the Canadian Government last year, and it is certain the matter will be raised in Parliament in the present session. It was suggested that the Government create a Crown Reserve of the whole of the northern coast from the Mackenzie River eastwards, and all the islands lying to the north of the continent. All traders would be expropriated and excluded, and the Government would run the country as Denmark runs Greenland.

At the same meeting of the Society to greet Dr. Rasmussen, Count Ahlefeldt-Laurvig, the Danish Minister in London, said: "The Government of that country (Greenland) is certainly not carried out with the object of financial gain to the Danish Government; it is a fatherly administration of the natives, who under it have prospered and multiplied," and the secret of the wonderful

success of the Danes in Greenland, of which the speaker was so justly proud, lay in the statement that it is "not carried out with the object of financial gain"! As long as it is possible for 35,000 white fox pelts to be traded for in the Canadian Arctic in a year, so long will the trader be compelled to exploit the Eskimo to obtain them.

The Eskimo is the most valuable aboriginal on the North American continent. Unlike any of the others farther south, he is irreplaceable, and without him any scientific work—save by such a unique party as Dr. Rasmussen's, who took their natives from Northern Greenland—is impossible. Any investigation of the mineral resources of this vast hinterland is almost impossible without native aid, and it is worthy of note that the Eskimo's essential wants, when not artificially stimulated, are few and simple.

In Alaska the United States Government have nobly redeemed their evil record of Indian treatment long ago, and their Eskimo are cared for and protected, and many own large herds of reindeer. Both in Alaska and Greenland the Eskimo population shows a steady increase. In the Canadian Arctic, wherever we look, the population shows a steady decline as soon as they come in contact with white men.

Government trading stations on the suggested Crown Reserve would be conducted on a policy which regarded profits as entirely subservient to the welfare of the Eskimo. It is obviously unjust and unreasonable to expect traders to risk their money and the lives of their employés on an altruist effort such as this. On the other hand, it has been pointed out to the Government that the administration of trading posts, hospitals, and police in the Crown Reserve would probably be more than self-supporting.

Any observant missionary, trader, or Royal Canadian Mounted Police officer knows the devastating effects of farinaceous foods and processed meats on the Eskimo system entirely unaccustomed to them; and to return the native to his normal way of living and his sea-animal food would be the first step.

Speaking of this, it is worthy of note that a Danish Government report states the essential vitamines are found in larger quantities in the meat and blubber of sea animals, and especially of seals, than any other known meat foods. Sir James Crichton-Brown has independently confirmed this. Of equal importance to the native is the conservation of the cariboo, and the introduction of reindeer, for the latter have accomplished marvels for the native of Alaska. There are to-day in Alaska over 500,000 head of reindeer, more than half being owned by Alaskan Eskimo.

Unquestionably, it is the Government of the country, be it Danish, United States of America, or Canadian, which has the most to gain, on the long view, by the preservation of the Eskimo within their territories. The United States to-day is not proud of its treatment of the North American Indian in the 'fifties and later. England is ashamed of her record with the now extinct and ethnographically vastly interesting Tasmanian native. Living as I do in Canada and knowing it well, I decline to believe, when the facts are known to the Canadian people, they will fail to endorse a policy framed to preserve for future generations the most interesting living aboriginal known to science, and the most useful native on the North American continent.

HENRY TOKE MUNN.

The Ghawarina

Owing to my absence in the Himalayan region during the last fourteen months I was unable to read Mr. Philby's paper on the "Dead Sea to 'Aqaba" in the *Journal* of August 1925 until a few days ago. In it and the subsequent

discussion mention is made of that curious African community in the Dead Sea Depression—the Ghawarina. Small colonies of these people occur north to near Jericho, and though despised by the Arabs are much feared on account of their reputed cunning and savagery. But the fear of an ignorant people is largely born of ignorance of that people's life and customs. I can recall no instance of violence recently committed by the Ghawarina.

In both 1919 and 1920 I got into touch with the Ghawarina near Jericho, but could ascertain little of either their origin or life. They spoke Arabic, and disclaimed knowledge of any other tongue. They were extremely secretive and suspicious. Any attempt to probe into their customs or manner of life met with no success in the time at my disposal; but I had opportunity to see both men and women at close quarters. Their features are of a modified negroid type, the lips not so thick, the nose not so flat, nor the hair so curly as is customary among Equatorial Negroes. In colour they are not so black as Nilotic races, therein more closely resembling the Somali type. Those I saw were of poor physique and martyrs to malaria.

Their origin is obscure. Local tradition traces it to an attempt by the Romans to colonize the hot Jordan valley with slaves, reinforced by "runaways" from the same source. The idea that they are the remnants of a pre-Roman and indigenous stock is scorned by local tradition. As was brought out in the discussion on Mr. Philby's paper, their origin has been traced by some to a Middle-Age colonization. Suffice it to say that their origin is obscure. I tried in vain to possess myself of a skull for anthropological examination, so that affinity to known African races might be traced.

There are two points, however, in connection with their origin, the one suggesting post-Biblical colonization, and the other to a much earlier origin. In the first place, one might imagine that some mention of such an unique community would have been made in the Bible if they had existed in those days. I am not aware of any Biblical reference, however vague, to the Ghawarina. The depths of the Dead Sea Depression—the Wilderness of the Bible—are seldom referred to, but dwellers in the Judæan Highlands had constant intercourse with Moab, and must have known of the inhabitants of the Wilderness if they had then existed, and yet no mention is made.

The second point is that the Dead Sea Depression as far north as 12 miles above Jericho is zoographically a tongue of the Ethiopian Region. A tropical fauna exists there closely allied to African and not to Palæarctic fauna. Among birds we find a nightjar (*Capr. nubicus tamaricis*), a starling (*Amydrus*), a babbler (*Crateropus squamiceps*), and a raven (*C. rhipidurus*), all of Ethiopian origin. If bird, plant, and insect life has spread north or remained north after the last glacial period, in congenial surroundings, it is not difficult to imagine that human life did likewise, and that the Ghawarina are as natural to the Dead Sea Depression as are the birds, plants, and insects among which they live.

Dr. Hogarth's inference that the peculiar climate of the Dead Sea Depression has exercised a modifying influence on the original stock may or may not be sound, but hardly seems likely.

It would be instructive if the Palestine Administration, under whose protection these elusive people live, could interest themselves to the extent of collecting evidence in anthropological material, language, customs, etc., which might throw light on what is now obscure, before a rapidly advancing civilization obliterates all trace by absorption or pressure.

R. MEINERTZHAGEN, Colonel.

Grazing Camels without Water

With reference to the point raised during the discussion of Mr. Rodd's paper on "The Origin of the Tuareg" as to how long grazing camels can go without water, it may be of interest to record the following.

Copious rains fell in this district, Gebel Elba in the Eastern Desert of Egypt, lat. 22° N., last November, and the vegetation that sprang up has been kept green by dew and further showers. The camels of my survey expedition drank last near Mersa Shab on November 22, and my sheikh el hamla does not propose to water them till about the end of Ramadan, April 14, perhaps. That is to say, they have already gone 103 days, and may go another 40 days, without water. They have moved my camp by very easy stages 440 kilometres in the 103 days. As to whether grazing, not working, camels could go six months in the cool of the year on green grazing neither my guides nor myself entertain any doubt whatever. But in hot weather it is a very different matter. I suppose Hassanein Ahmed Bey's march in ten days from Owenat to Erdi, 450 kilometres, in May represents about the best that could be done without either water or grazing.

G. W. MURRAY.

Desert Survey, Egypt.

MEETINGS: ROYAL GEOGRAPHICAL SOCIETY: SESSION 1925–1926

Tenth Evening Meeting, 22 March 1926.—The President in the Chair.

ELECTIONS.—Rev. Robert Andrew Agnew, M.A.; John Bain; Cyril Douglas Hollyman Ball; Stafford Bourne, B.A.; Major George James Gordon Gerald Cumine, D.S.O.; Lieut. W. J. Dynes, R.E.; Howard Thornton England; Sir John Frankland Payne Gallwey, Bart.; T. A. Glover; Charles Kemp Herring, B.A.; J. Edwin Holmstrom, B.SC., A.C.G.I., A.M.I.C.E.; Miss Edith M. Husk; Dr. Lim Boon Keng; Major Henry Keswick, M.A., J.P., F.Z.S.; Horace Frederick Leaf; Miss Mary Spencer; Sergei de Vesselitsky; John Howard Whitehouse.

Paper: The Rio Branco. Dr. Hamilton Rice.

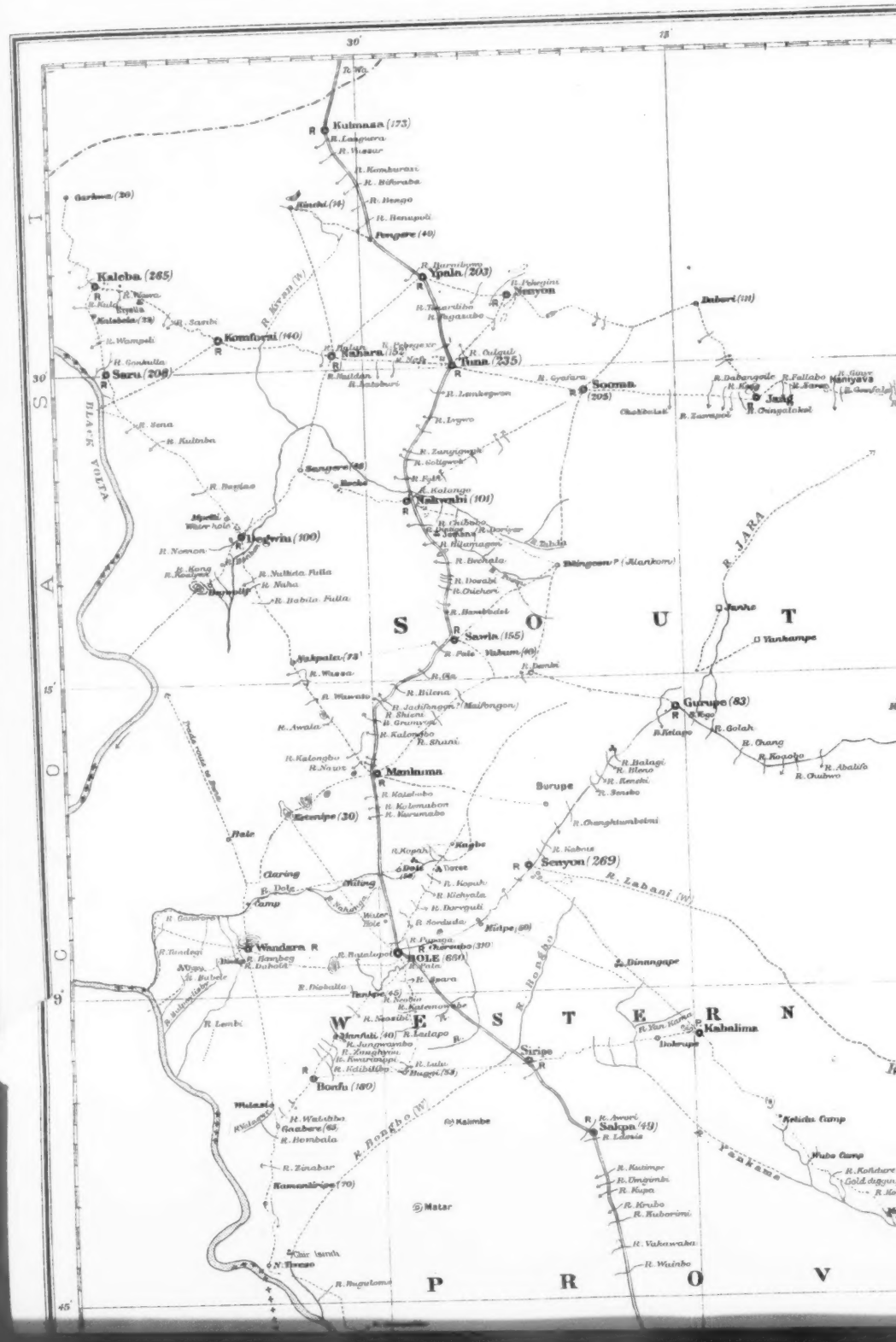
Eleventh Evening Meeting, 12 April 1926.—The President in the Chair.

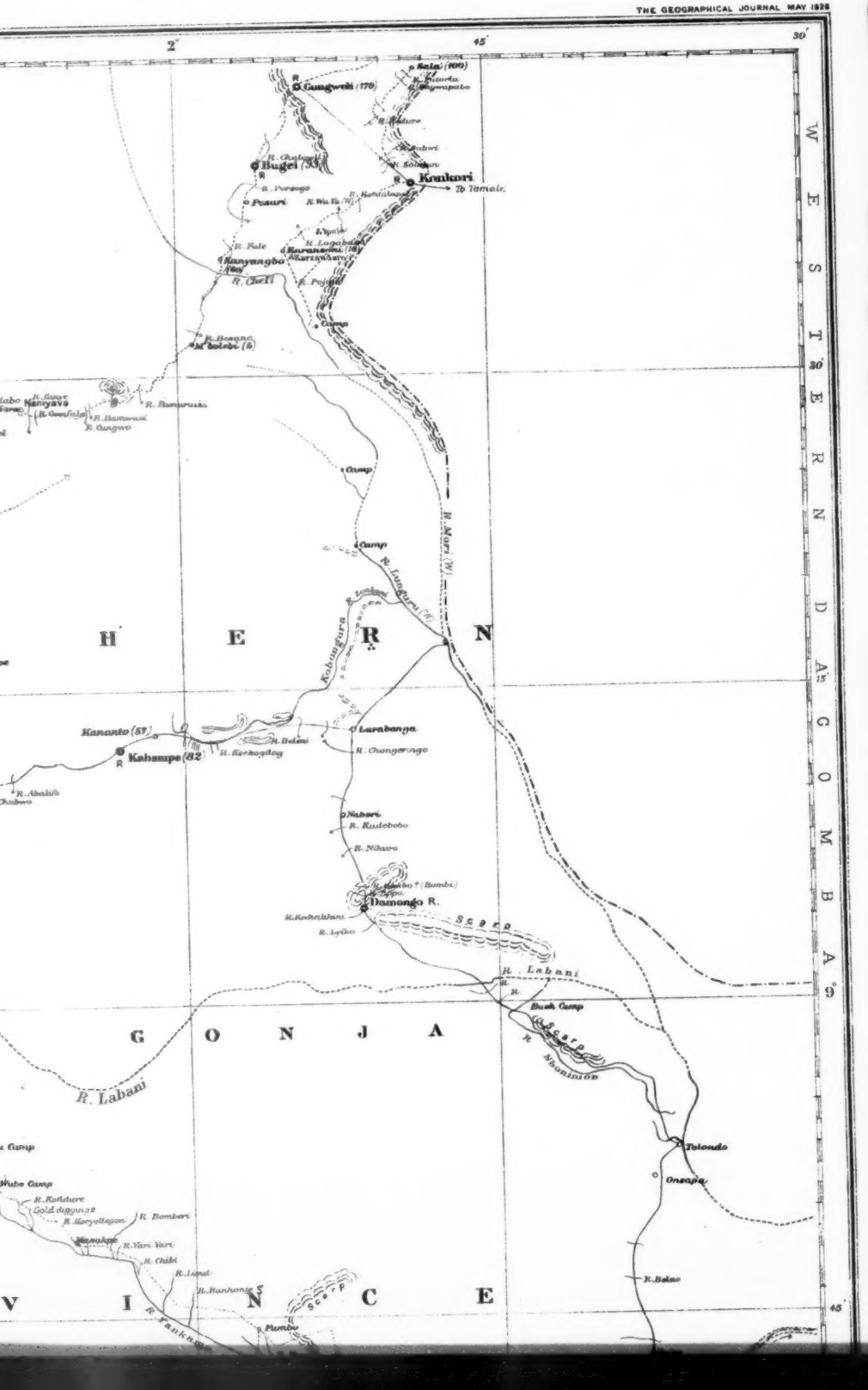
ELECTIONS.—Ernest Wallace Benson, M.C.; Sydney William Boldon; Miss Elsie Alice Brown; Capt. E. Doole; Ebenezer Henry Hawkins; Rev. Walter George Ivens, M.A., LITT.D.; J. Parke Jackson; Capt. Duncan McCallum, M.C.; Major Charles Pratt, M.C.; Walter Stanley Groveham Proctor; The Lady Rawlinson; Rev. Ray L. Six; Charles Hampson Slade; Herbert Cecil Stiebel, O.B.E.; James Colin Swayne; Leo Percy Thomas, B.SC., F.C.P.; Edward Wilding.

Paper: The Ascent of Mount Logan. H. F. Lambart; read by Dr. T. G. Longstaff.

Sixth Afternoon Meeting, 19 April 1926. Sir Charles Close, Vice-President, in the Chair.

Paper: Tone and Colour in Scenery determined by Light and Atmosphere. Dr. Vaughan Cornish.

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R. Lyako
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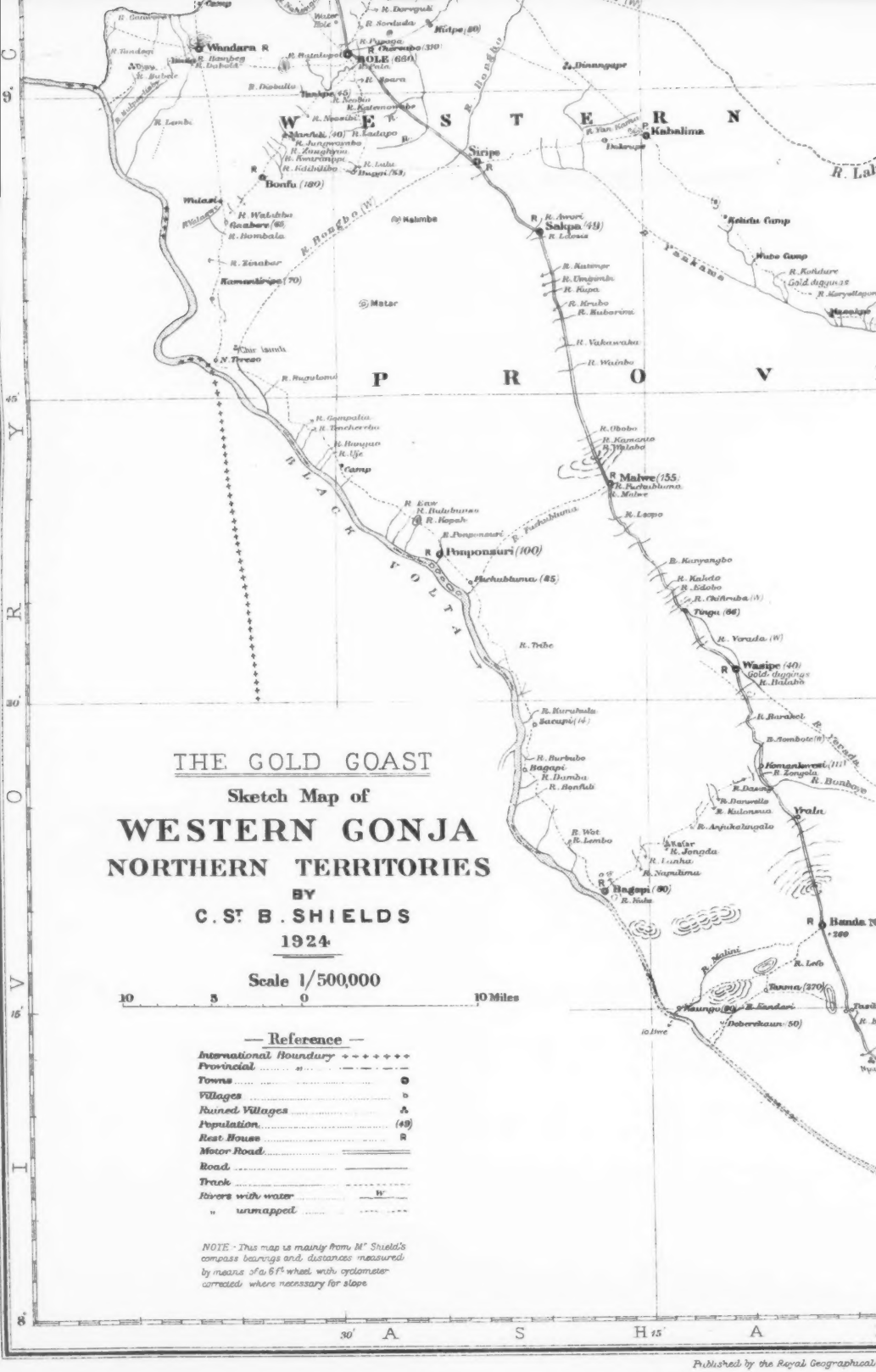

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THE GEOGRAPHICAL JOURNAL

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The Geographical Journal

Vol. LXVII No. 6 June 1926

A RECENT VISIT TO GUDRU AND GOJJAM

C. F. Rey

Read at the Meeting of the Society, 26 April 1926.

SINCE I had the privilege of reading my first paper on the subject of Abyssinia before the Royal Geographical Society nearly four years ago, my wife and I have been able to make two further visits to that country, and to parts differing materially from each other, both geographically and racially.

Our first visit in 1919–20 was confined to Shoa, and from Addis Ababa we undertook a number of short treks to different parts of that province, of which the population, though largely Abyssinian, is very much diluted by inter-marriage with the Shoan Galla and with conquered negroid races. The country itself is high, Addis Ababa being near the south-eastern extremity of the main Abyssinian plateau at an elevation of approximately 8000 feet, just below and to the south of the Intotto Mountains, which run to a height of about 11,000 feet.

On our second trip in 1922–23 we travelled southward from Addis Ababa round Lake Zwai and in the Arusi country, keeping to the west of the Arusi Mountains. This country is lower, lying indeed partly within the Great Rift Valley between the Somali plateau and the Galla Highlands, Lake Zwai itself being at an elevation of about 5000 feet.

The people here are Galla, different branches of this great race. The Arusi Galla Wylde brackets with the Masai as "the two most warlike and savage tribes north of the equator in the eastern part of Africa;" but we found them pleasant enough to deal with, though shy and wild.

Our third trip, from which we have just returned, was through Gudru to the more purely Abyssinian country of Gojjam, lying north of the great southerly bend of the Blue Nile, between this river and Lake Tana.

The difference in appearance between the races is strongly marked, both as regards features and colour, and traces of the three peoples from which the mixed population of Abyssinia derives its origin, *i.e.* the Semitic, Hamitic, and negroid, are clearly evident.

Nor do the social and political conditions of the people of Shoa, Arusi, and Gojjam differ less widely, and any generalization as to the

country as a whole would be wide of the mark if based on a visit to one only of these three districts.

The Shoan Galla have largely absorbed the attributes of their Abyssinian conquerors, and to a great extent have been Christianized. The Arusi and other Galla to the south are, on the contrary, mainly pagan, and at the time of our visit at all events showed no traces of civilization.

They possessed large herds of cattle, raised a limited amount of food-stuffs, and those living near the lake indulged in fishing, for which purpose they used the most primitive form of canoes, made of reeds lashed together at stem and stern, and floating in, not on, the water.

The route from Addis Ababa to Lake Zwai which we followed ran south-west for some 40 miles, and then south for another 40 miles. It was rough but picturesque, well wooded, and mountainous, and the lake itself, about 25 miles long (we made a complete circuit of it), was very attractive, lying within and below a circle of mountains, surrounded by mimosa woods and other tropical and semi-tropical vegetation Large trees of the wild fig variety ran almost down to the edge of the water, and all along the reedy shores we saw a great number of birds, pelicans, storks, flamingoes, cranes, and ducks of many different varieties. The water of the lake was fresh, though the lakes lying immediately to the south are, as Mr. Hodson has pointed out, salt or brackish. The climate was quite healthy in the dry season, there being then no mosquitoes; and though the day temperature was high the nights were extremely cold.

Since our visit in 1923, I understand that an enterprising German has actually managed to get a motor car to Lake Zwai by an easier route, so I suppose that the district is now better known and consequently less interesting.

But there are fortunately still some parts of the world which civilization and tourists have not spoilt for the traveller, and a few of these are yet to be found in Abyssinia. It was with the view of travelling through one of these districts that our recent trip was undertaken.

Our "jumping-off" ground was Addis Ababa, about 500 miles from the coast, and I am bound to say that that once fascinating African town has lost much of its charm since our previous visit three years ago. In the sacred name of "progress," civilization has begun to spread a veneer over it: motor cars now defile the roads which a short while back were merely tracks for our ponies; some of the wealthier Abyssinians have begun to wear boots and to live in stone-walled tin-roofed houses; and the small number of European traders has appreciably increased.

It was accordingly with pleasure that we got our caravan together and trekked off into the bush, into Abyssinia as distinct from Addis Ababa, where the march of centuries has left the country unchanged.

But even in Addis Ababa the old yet remains side by side with the

new, and the motor car and sewing machine have not displaced the ancient ceremonies and customs, the habits and dress of the vast majority of the people, and the curious and interesting sights to be seen in the capital of Ethiopia. For example, while we were there this time a new road was being constructed, and in the old-time feudal manner the Regent himself placed the first stone in place; chiefs and high officials followed his example; and in a little while some 5000 or 6000 men were busily engaged depositing stones and gravel along a 2-mile stretch of road. They generally carried one small stone each, or a handful of earth in a leaf, most of them on foot, but some on mules riding with a minute portion of soil in a cactus leaf on their shoulder. And every morning for nearly a week the Regent surveyed the work until the road was ready; but—the modern touch—from his motor car! I have seen it stated that the practice was not so much a feudal survival as a method introduced by Menelik to induce his work-shy people to labour; but I am very doubtful as to this, and there is evidence of the custom dating back beyond his time.

Another change we noticed in Addis Ababa was climatic. Rain fell for a week during the beginning of November both this year and last, a thing unknown in the memory of the oldest inhabitant, and the only explanation I could get of this extraordinary happening was that the rainfall during the last two wet seasons had been abnormally light; the rains had ended this year as they always do, on September 26 or 27, but last year they ended on September 1.

However, it had all ceased before we started our trek, and a rainbow closed this climatic irregularity. Incidentally, it may be of interest to note that the Abyssinian national colours of red, yellow, and green are derived from those of the rainbow, as typifying the union of heaven and Ethiopia. Knowing their claim to divine association, I am a little surprised that they do not claim that the rainbow derives from the Abyssinian national colours.

One of the delights of planning a trip from Addis is that, while in theory everybody knows the route to everywhere, no one really ever knows any route when it comes down to hard fact. So, although we received unlimited advice, we could get no definite geographical guidance, and eventually started off without a guide, trusting to a small map, a smaller compass, and that measure of good fortune without which no trek can be successful.

We had been most kindly received by the Empress, and by the Regent, Ras Tafari, who was much interested in the trip. He had given us the necessary permits, without which no one can move in Abyssinia, some rifles for our men, and had offered us mules and other conveniences. We had experienced from Mr. Bentinck that kindness and hospitality which are associated with the British Legation, and had drawn upon the inexhaustible supply of information of Mr. Zaphiro, that "guide, counsellor, and friend" of all British travellers in Abyssinia. And we

had got together a splendid lot of men, most of whom had been with us on previous visits to the country. So it was with confidence that we loaded up our mules early on the morning of December 16, and we merely derived mild amusement from the fact that the said mules, having been kept waiting (and feeding) for a week, had decided views about their loads, and proceeded to re-distribute them rapidly and efficiently in all directions.

SKETCH-MAP OF GUDRU AND GOJJAM

The Abyssinian "nagadi" loads his mule in a manner quite *sui generis*. The two packages are fastened together high up on the saddle so as to make the whole thing as narrow as possible, and then packages and saddle are lashed on to the mule by long hide ropes passed under the belly. The saddle has no girths, and consists merely of two long pads, covered by a sheepskin, attached to a piece of wood curved nearly at a right angle, which rests on the withers.

Being already familiar with the Abyssinian-Galla province of Shoa, and the Arusi Galla district, where Abyssinians figure only as soldiers

HOT-WATER SPRINGS FROM ROCKS, AMBO

VALLEY OF THE GUDIR RIVER LOOKING EAST

IN THE PASS ABOVE THE GUDIR RIVER

FALLS ON THE GUDIR RIVER

STONE BRIDGE OVER THE GUDIR RIVER

CHURCH OF ST. MARK. DEBRA MARKOS

or officials, we wished to penetrate as far as possible into the purely Abyssinian country of Gojjam, to go there by a new route, and to effect the crossing of the Blue Nile in doing so. Had we known what the crossing of the Abbai was like at the place were we struck it, we might perhaps have changed our ideas; but I am glad we did not.

We proposed to push west as far as Ambo, and then to turn north from there through a district which the map leaves blank, and which, so far as we could find out, no one had traversed. But, for reasons I will explain later, we were forced to push further west still, to cross the Gudir river, and then only to turn north through Gudru to the Blue Nile. From there we went on to Debra Markos, the capital of Gojjam, and, being unable to proceed farther owing to lack of time and for other reasons, returned by a different route to Addis Ababa.

The country is very mountainous and rent by valleys in all directions, with numbers of rivers and streams; on one day's march alone we crossed eleven. The first river was a branch of the Akaki, a tributary of the Great Hawash river. The ford here was about 2 feet deep, the stream about 40 feet wide between steepish banks; the main stream runs through a gorge about 400 feet in height, and on it are some fine falls well over 100 feet. The next day we camped at Addis Alam, about 30 miles from Addis Ababa, a pleasant little place of perhaps 1500 inhabitants, embowered in olive trees and junipers, in which is a monastery and the well-known Church of Mariam, and near which (at Gennet) is a royal palace, both built by Menelik, and both decorated (somewhat crudely) by Indian workmen.

Our route was very attractive. We skirted the mountain forest of Jam-Jana, riding over high mountainous country affording magnificent views through woods where flowers and creepers abounded, delightful in their colour and scent. It was very rough going up and down steep mountain tracks, across many streams, and through deep ravines, very much to be preferred to the ordinary caravan tracks, which we sedulously avoided.

The ordinary day's march for the caravan was about five hours, about 13 to 14 miles, or a little over, on an average. For Abyssinian mules it is unwise to do more on a longish trek, as owing to the peculiar method of saddling they develop very bad sores, and thus—apart from the cruelty of it—become useless. We did not lose a single mule, whereas a recent traveller is reported to have said that no fewer than twenty animals died during the trek.

Two days after leaving Jam-Jana we crossed the Hawash river near its source, and a little later actually camped at the source—a beautiful spot called Warka, thickly wooded, abounding in flowers and palms.

It was not far from here to the Dabissa river, which we crossed by a wide and difficult ford (of which we were unable to find out the name) near some falls, a beautiful spot. The river opened out to about 60 feet

at the ford, and then fell over rocks down some 15 feet, narrowing again between banks that were thickly covered with vegetation.

The day after we reached Ambo, on the Huluka river, neither of which is named on the 1/2,000,000 General Staff map. Ambo is quite a fair-sized place, straggling over a wide area, and placed, as are all Abyssinian towns, high up in the mountains just below the crest.

We crossed the river just above the town by a difficult ford about 2½ feet deep and 20 yards wide. The current is strong and the passage full of boulders and holes. A little lower down the river runs amid quantities of euphorbia trees, between high cliffs which almost meet in one place where a bridge has been thrown over, and this affords an easier though more roundabout crossing.

On the western side of the river are the locally famous hot-water springs. There is a gully between two cliffs, and from one of these hot water, which is alleged to possess medicinal properties, runs out in a small but steady stream. But the most curious feature was, that across the mouth of this gully stretched, in a long irregular line for some 20 or 30 yards, a quantity of whitish grey rocks of various sizes, and from the tops of these rocks in a number of different places hot water was trickling out and running down to the ground. The rocks varied from quite big boulders to comparatively small stones, and I have been quite unable to find any explanation of this curious phenomenon.

The main stream of water has been piped into a stone bath by the ex-Emperor Lej Yasu, and over this he caused to be erected some rough huts. There are two baths in one of the huts, divided off from each other by a piece of once-white cotton sheeting, and in each of these I found some half-dozen bathers submerged up to their necks. The water runs through these two baths into a third and separate bath in another hut, which is reserved for persons suffering from diseases of various kinds.

Here we encountered our first real difficulty. We had intended to turn north and cross the country lying to the east of the Gudir; but it was impossible to get any one to go with us. They maintained that we should have to travel for several days through waterless country; that the tracks—where there were any—were impossible for loaded pack-mules; and that "shiftas" (*i.e.* brigands) abounded. And every one wished us to turn back and then start north-west along the route followed in 1922–23 by M. and Mme. de Coppet. This we flatly refused to do, and eventually succeeded in finding a native who said he had once gone to the Blue Nile by the route west of the Gudir, and agreed to guide us by that route. Needless to say he did not know the way when it came to the point, but he saved the situation at the time.

After this we rode through entrancing mountain woodland scenery down to the valley of the Gudir river, leaving the imposing peak of Tulu Dimtu far to the south, and through thickening woods clambered down a precipitous descent to the Gudir itself, a large rushing stream between

cliffs 40 or 50 feet high, about 60 feet wide, and too deep to ford with safety. The bed of the stream was a mass of rocks and boulders, and it dropped over a series of small falls for nearly 100 yards just where we crossed. This was an exquisite spot, and here we spent Christmas Day, having covered some 84 miles. To add to its beauty we found an old bridge—there is a newish horror some miles further south—which was most picturesque, and, strange to say, pretty firm though dilapidated. The bridge was obviously old; the peasants could tell us only that it had always been there; in any case it was quite unlike any other bridge I have ever seen in Abyssinia. It consisted of a single arch thrown across the narrowest part of the rocky gorge through which the river ran; it was strongly buttressed, built of stone, and what looked like lime mortar. Below the arch ran an old weather-worn beam which seemed, old as it was, to be of later date than the bridge itself. The footway was beaten earth, and there was no handrail or parapet of any kind.

The day's march had been arduous, climbing up and down ravines, in and amongst great peaks, covered with woods, skirting the shoulders of mountains, fording numberless rivers, and riding through forests of mimosa. We found our old friend the euphorbia again, and also quantities of blackberries. The camping-ground itself was on a bluff, on two sides of which ran the Gudir, and amid the panorama of mountains one could see the river winding away amid trees towards the north to join the Blue Nile, known here as the Abbai.

The pass up which we rode north-west the next day was equally beautiful, through thick woods full of flowers and flowering shrubs, and the view from the summit was really magnificent. Eastwards we could see for miles across plains and valleys mountain-tops scattered in every direction, whilst far below us lay the deep valley where the Huluka and Gudir rivers joined.

This district had up to some three years ago been overrun by "shiftas," and we saw several stockaded enclosures in which the "nagadis" (travelling merchants) would spend the night with their caravans of mules for safety. But the Governor had then bestirred himself to some point, and after a short and spirited effort resulting in the decoration of many trees with the bodies of the disturbers of peace, law and order had resumed their sway.

We had now passed Toke and Shinkule and had got into Chelia, of which Gedo is one of the principal towns. We reached it on December 28, and had wished to camp here under a large tree, but had been driven away from it by the attention of myriads of driver ants. I had never seen our men so active in shifting camp as they were on this occasion.

Toke was a small village and Shinkule merely a collection of huts; both however were well situated on hillsides by streams, where trees and wood were plentiful. Gedo is however a larger place of about

a thousand inhabitants, close to a biggish river of the same name. Like all the villages we passed, it consists solely of mud-walled, grass-thatched "tukuls," each with its single entrance and innocent of all windows. Unlike other villages, however, it was, at least in part, enclosed by a high fence, though it straggled out beyond it.

The vegetation between the places named above was very beautiful—olive and fig trees, mimosa and date palms, jasmine and maidenhair fern, were all met with in profusion.

We were now making for Mount Amara before turning north; and rising still farther, camped at Gwoda Gworo, near Mount Tibbi, on December 29, at something over 10,000 feet. Here the cold was very trying during the night, and in the morning, on going out of the tent at about 6 a.m., I found that a heavy dew had fallen in the night, followed by a hard frost, and that our breakfast table was covered with ice, though quite soon afterwards we were grilling on our ponies' backs.

Here we were fortunate enough to secure roots and seeds of the Abyssinian red-hot poker plant, which, I believe, has not yet found its way to this country, and a few days before we had come into the belt of those remarkably beautiful trees, the "Kosso." The flowers hang in great scarlet bunches, as large as a big cluster of grapes, and very much the same shape, and as the trees run to a considerable height, up to 40 feet or more, and there are many growing together, the effect is extremely beautiful. The flowers turn brown when they are over, and are then crushed up into powder and taken as medicine to cure tape worm by all Abyssinians, high and low. The disease is almost universal as a result of eating so much raw meat.

We also came across another rather fine tree, the Danissa, which is not only picturesque but also extremely useful, as from it the natives make rope with which they bind together the framework of their somewhat primitive "tukuls," *i.e.* huts.

We had now left the country that is traversed by travellers making for the west, and were well on towards the little-known country of Gudru. Before actually reaching it, however, we had a very picturesque welcome at Lencha Chacha on December 31, from the sub-governor of the adjoining province. We heard trumpets being blown far away in the mountains, and as the sound grew louder we saw an imposing array coming down the hillside, mounted and on foot, and fairly bristling with rifles, spears, and swords. The governor was riding a mule, his war-horse being led behind him, and dismounting he came into camp with his followers, expressing his delight at meeting the first white people who had visited his country. He said that he had heard that a foreigner, a great personage, was travelling in his district, and that he knew he must be a very great personage indeed, because he had brought his wife with him.

I may take this opportunity of saying that my wife's presence was not

only always a source of absorbing interest to these people, but also of the greatest possible help in every way. They seemed thereby inspired to redouble their natural courtesy, already great, and by her tact and resource in dealing with them we received assistance and facilities which I am sure would not have come my way had I been alone.

We were invited to the Fitarauri's home to meet his family, a somewhat unusual honour, and simple though the surroundings were, Fitarauri Desta did the honours as though he were in Buckingham Palace. His residence was at the top of a steep rise on the slopes of Mount Amara, and was enclosed within a triple stockade of stout pointed sticks about 8 to 10 feet high. A narrow path led through an even narrower gateway, into the inner yard, and in the midst of this was the house. It was a round tukul about 35 feet in diameter, made of "chika" (mud and straw). The roof was of thatch, and inside it was neatly finished off with plaited coloured straw in concentric rings.

The room was divided into two unequal parts by a long strip of white "alougedid" hung along posts of roughly hewn wood supporting the roof, and the furniture—wholly native made—consisted of a large bed, a sort of divan, a basketwork table, and some chairs. Some Eastern rugs covered the divan and table, and portraits of the Empress and Regent adorned the walls.

Fitarauri Desta was very loth to let us go, and when we did, he provided us with a guide to our next camping-place who really did know the way, a fine type of Galla, and a really first-class horseman.

We were fortunate enough while here to see part of the ceremonies attendant on a Galla wedding. About fifty men dressed in freshly washed white robes rode headlong across the plain to fetch the bride from her native village, and after about four hours of the most energetic chattering, the bride was mounted on a mule and in the midst of the troop rode off to her new home. The Gallas, especially in this district, a great horse-breeding centre, are fine horsemen, and they "showed off" to great advantage, galloping their ponies madly over fearful ground, engaging in mimic fights, pursuing the defeated enemy, and generally giving us a great circus display.

The Fitarauri had presented us with an ox, some sheep, bread, milk, eggs, fowls, etc., and our men improved the next day's shining hour by a great raw-meat banquet. As they could not eat the whole ox at one sitting, they cut part of it into strips to dry in the sun, and quite soon the camp was a regular raw-meat larder, and hundreds of uninvited guests in the shape of vultures, hawks, and crows were circling round overhead, or squalling just out of stone-throwing range waiting for a chance bit, to be shared with the half-wild dogs that seem to spring out of the earth wherever a morsel of food is to be had. And later on at night the jackals and hyenas would come for their share, making the night hideous with their complaints; and in the morning peasants would collect any half-

burned logs or empty tins, so that all traces of our passage would be most effectively cleared up.

We reached the "kella," or customs frontier post of Gudru, on January 1, and after passing through the villages of Gabati and Dilalo and the townships of Konbolcha and Ambabo on the next three days, we were once again to experience the hospitality and courtesy which I have always found amongst the Abyssinians. The governor of the country, Dajazmach Achamelli, had heard of our arrival, and had had horsemen scouring the place for us. He arrived whilst we were in camp at Karsa with a still more imposing retinue than his predecessor, and fairly overwhelmed us with the amount of livestock and other foodstuffs which he brought us, relays of men bringing in every conceivable kind of supply at intervals from 4 till 8 o'clock.

Three Fitarauris accompanied him, and to these were all assigned different rôles in regard to facilitating our further journey towards and across the Nile—and very well they carried them out.

The country of Gudru appeared to be well administered, and certainly it was the most beautiful of all the country we passed through. It is exceedingly mountainous, thickly wooded, well watered—on one day alone we crossed nine rivers and streams—and abounds in flowers, flowering shrubs, and flowering trees. To name only a few, we saw yellow and white single roses, masses of scented white jasmine, wild raspberries, blackberries, hollyhocks, wild mignonette, red-hot pokers, scarlet aloes, yellow daisies, date and other palms, both yellow and white mimosa, with olive and fig trees, and many other flowers and bushes, of which the names and species were unfamiliar to us, and of which we have brought back seeds and specimens for Kew Gardens. One particularly lovely ride was through a long wood of trees about 20 to 30 feet high, so thickly covered with bright yellow flowers in the shape of fluffy balls that the leaves were almost hidden, whilst below and in between them were large bushes of a mauve flower. Photography can give but a feeble idea of the country, mainly owing to the loss of colour.

There is a good deal of cultivation, and villages are fairly frequent. We passed through two quite large ones—almost towns in the African sense of the word—Konbolcha, lying about 25 miles as the crow flies north of where it is marked on the map (about 50 miles as we went), and Ambabo, at the northern edge of the spur of mountains running out towards the Blue Nile, and about 20 miles from it.

These two places each cover a considerable area; it took nearly three-quarters of an hour for our caravan to cross the latter. They are not stockaded or enclosed in any way, but straggle out on no sort of principle, each "tukul" having a largish piece of ground belonging to it, which may or may not be enclosed by a rough fence. The cultivated fields beyond the villages are not enclosed in any way, nor even divided from each other.

The peasants are largely Galla, and do not differ markedly in feature from their brethren farther south. We found them courteous and helpful, much more so than the Gallas in Shoa, nearer to the capital.

Soon after leaving Karsa and our good friend Dajazmach Achamelli, we began to approach the valley of the Blue Nile, and I shall not easily forget the first glimpse I got of it on January 5. Through a cleft in the hills we could see the steep cliff of the opposite bank towering up in the distance, and between it and ourselves far below lay a tortured mass of peaks and rifts and ravines that promised some fairly strenuous work for the next few days. Nor did the reality belie the promise.

Technically, the Blue Nile has been described as a "torrential river with a bed of shingle in a deep valley." That seems rather a cold-blooded way of referring to a river about which so much romance has clung. Lucan credits the legendary Sosostris with the keenest desire to penetrate to this river. Cambyses made an ill-starred attempt to do so. Alexander the Great sent out an expedition for the purpose, as did the Ptolemies Philadelphus and Euergetes. Cæsar displayed great interest in the subject, and Nero sent two centurions to search for the head of the Nile.

But it remained inviolate until in the seventeenth century the Portuguese, and in the eighteenth century our great traveller James Bruce, reached the much-sought-for river head. Even these discoverers fell into the error of thinking that they had found the source of the great Nile, and Bruce indeed hotly denied that the Portuguese had ever been to any sources at all.

Since then the great value of the Blue Nile to Egypt and the Sudan has been learned and appreciated. And recently the river and the great Lake Tana through which it runs, and south of which it rises, have assumed an added importance, for it has been realized that to ensure adequate and satisfactory irrigation in the Sudan it is necessary to regulate the flow of water from the lake down the Blue Nile and a very interesting report on this subject has just been published.

It is an eminently simple proposition. Between March and July the waters of the Nile are inadequate for the agricultural needs of Egypt and the Sudan. For the rest of the year they are in excess of requirements, and it is proposed to store the surplus during this period and let it out as required.

The project—which has been under consideration for a quarter of a century or more—is one which would benefit both Abyssinia and the Sudan, and also Egypt. At the present time the Blue Nile is of little or no benefit to Abyssinia, its waters are not navigable for any distance, and like all rivers in that country it is a bar, not an aid, to communication.

The discharge measured about halfway between the Muger and the Gudir rivers, one-third of the way from Tana to Roseires, at the end of the dry season amounted to 28·6 cubic metres per second; and the

estimate made for the rainy season at the same place was from 2000 to 3000 cubic metres per second. The difference is tremendous, and gives some indication of the preventable wastage. The total discharge at Soba in 1920–21 was 47 milliards of cubic metres.

Incidentally it may be mentioned that the correct spelling and pronunciation of the name of the lake would appear to be Tana, and not Tsana, as is generally thought. That T is the fourth form ጠ of the "explosive" letter ጠ and not the ተ corresponding to our T, nor the sibilant ፀ corresponding to our Ts.

But even now the river has not been explored along all its reaches. For example, no Europeans have, I understand, crossed where we did; it can only be forded at such fords as exist between Salale, Gindabarat and Gojjam during a limited portion of the year, and for the remaining months Gojjam is entirely cut off from that portion of Abyssinia lying south of the river owing to the rains.

At the place where we crossed I should, very roughly and approximately, estimate the width of the valley between the tops of the opposite escarpments to be not less than 10 to 12 miles in a direct line, the drop being approximately 4000 feet. The wall of the valley extends in almost a straight line on both sides, and with the exception of the platform of Chara the descent on the south bank is almost continuously precipitous. It is slightly less so on the north bank, especially towards the top of the valley, where the track is more winding. As is explained below, the conditions as to climate and vegetation on the two banks are similar, but the variation at the different altitudes was very marked.

We were met at the top of the valley by another sub-governor, who provided us with mules and guides to take us halfway down the descent, and a delightful person he was. He was very proud of his district, which indeed is full of historical associations. It was the scene of the great conflicts between the Negus Tekla Haimanot of Gojjam, the father of the present ruler (who had extended his rule some distance south of the Abbai) and the Emperors John and Menelik; and even to-day the people of the country show great reverence to the memory of Tekla Haimanot, the popularity of whose son extends far beyond the limits of his own jurisdiction.

The town of Koa, near here on the south bank of the Abbai, was founded by the late Negus, who built therein quite a large church dedicated to St. George, which is a centre of attraction to-day.

The climb down to Chara on January 5 was really very stiff. We were obliged to abandon our mules for the last one and a half hours and to walk, or rather slither, down the rocks. And how the loaded pack-mules and our ponies managed to descend I cannot imagine; I did not care to look at them. The track—little more than a goat-track—wound down through woods and bushes and creepers and flowers, and beautiful though these were, they did not exactly assist our progress, especially as

A DJANDI AT KITAL ON THE ABBAI

THE VALLEY OF THE ABBAI LOOKING NORTH FROM CHARA

CROSSING THE ABBAI AT KITAL

THE ABBAI ABOVE SHIFARTAK FROM 2000 FEET ON SOUTH BANK

VALLEY OF THE ABBAI FROM ANJIM LOOKING SOUTH

FORDING THE ABBAI AT SHIFARTAK

the large majority of growing things in Abyssinia are over-adequately supplied with thorns.

The view however from Chara—about halfway down—was very fine, and the mauves and browns and blacks of the peaks and rugged walls on the other side of the chasm that is the Abbai valley made a gorgeous picture especially as night drew on, and a magnificent sunset lighted up the valley.

Two somewhat interesting features we noticed here. The village, which is of fair size, is situated on a sort of platform on the side of the cliff, and to get a little more space for their crops the inhabitants have gone in extensively for a sort of terrace irrigation, not commonly found in the country; the whole hillside seen from a distance seems to have been cut into huge steps hundreds of yards long.

The other curious feature was a natural formation just above the village; jutting out from the face of the cliff and quite detached from it were half a dozen enormous pillars, over 100 feet high, I should say, almost square, as if they had been roughly hewn out by men.

On the morning of January 6 we dropped during two hours and a half down the remaining distance to the Abbai itself ("dropped" not inaptly expresses our method of progression), and the nature of the country through which we passed changed entirely. The soil got poorer and poorer, rockier and rockier; we passed a good deal of pink-and-white quartz-like formation, and the cultivation of foodstuffs of all kinds ceased entirely.

The lower zones of the Abbai here are inhabited by a tribe of about 3000 persons who grow no crops, but live entirely by raising cotton, which they sell or exchange for food and the few other necessaries of their very primitive existence. And consequently the only form of life other than stunted forest trees to be seen were cotton bushes, which we were surprised to find growing there. The same conditions obtain on the other side of the Abbai immediately opposite this district.

Incidentally I may mention that this cotton, though of poor quality, commands an absurdly high price in Abyssinia, whilst cotton of very much better quality grown in other parts of the country fetches a higher price than raw cotton at Liverpool. The reason is that very little is grown, and it is in great demand for making "shamas," the toga-like garment which every Abyssinian wears or wants. Only the comparatively well-to-do can afford the home-made garment; the imported article is much cheaper, but this does not get far afield from the main centres.

We did not actually see the river until we were half an hour's climb from it, so steep is the drop; and when we did get down it seemed a very forbidding-looking spot, Kital by name. The stream itself was about 250 yards wide at the crossing, greenish in colour, of considerable depth, the current running strongly, deep and silent, opposite us, but

foaming slightly some 300 yards below as it ran round a wide bend over some rapids.

It was difficult to estimate the depth with any accuracy, but the swimmers got out of their depth less than 10 yards from the bank on either side, though this was in the middle of the dry season. High above us on both sides were the great grey cliffs covered with stunted undergrowth, and along the banks was a narrow strip of large stones interspersed with huge boulders. The heat down in this rocky prison was intense, and so hot was the stone that it was painful to lay one's hand on it.

From the human point of view the scene was quite picturesque. Our little party, somewhat travel-stained and dilapidated, were gazing spell-bound at the water, none of them having crossed before, and the escort of the sub-governor who had come down to see us over were leaning on their rifles, making pleasant jests to our people as to the manners and customs of the crocodiles with which the river is infested.

Grouped naked on the rocks were some forty swimmers who were to take us over; and on the opposite bank were the officers, soldiers, and guides whom Ras Hailu of Gojjam had sent down to meet us, prominent among them being two very brilliantly caparisoned mules destined to carry us up the somewhat inaccessible-looking cliff on the other side.

The first passengers to make the crossing were the animals, and soon mules, ponies, donkeys, and a couple of our gift oxen were, more or less willingly, amid much rifle-fire to keep off the crocodiles, being driven into the water, headed upstream, and, guided by the swimmers, impelled towards the opposite bank, which of course they reached a good deal farther down. The most difficult to manage were the oxen, and one of them—also one of the mules—reached the shore upside down, their legs alone projecting from the water. They appeared little the worse for it however, though they seemed afterwards to want to keep as far away from the water as possible.

We were to make the crossing on "djandis," and on seeing one for the first time I was reminded of the description given by one of the old Portuguese Jesuits nearly three hundred years ago of crossing the Abbai some distance above where we were to do so. He says:

"This is the passage over the Nile frequented by travellers who come from the Court and Province of Dambeha for the Kingdom of Gojama, the territory called Bed, the passage over in boats, made of grosse and thick matte, strongly joyned and put together yet not secure from falling in pieces, which often happens and the passengers left in the water; . . . many swim over, so do all the beasts, and both man and beast go in danger of some mortall accident from the sea-horses and crocodiles, both bred in the Nile, and infesting the passages."

However, it was not as bad as that, and our "djandis" had evidently been improved in the passage of the centuries.

A "djandi" is a tanned oxskin, round the edge of which are a number

of holes. It is laid flat on the ground, dried grass piled on it, and then made up into a sort of package by hide ropes pulled through the holes round the edges. If goods are to be transported they are put inside; if human beings, they squat "à la Turque" on the top. In either case swimmers pull and push the unwieldy craft, which rocks and rolls like a channel steamer on a bad day; it looks much more alarming than it really is, but I cannot really blame some of our men who, after seeing the first "djandi" pulled over, declined firmly to sit on the craft, and so were packed in the straw inside and tied tightly up, two of them head to tail, and towed over in this way. How they escaped suffocation I cannot imagine.

The great moment of the day was the passage of my wife, for the men had been threatened with dire penalties if anything happened to her. Six swimmers pulled the "djandi," six pushed, about a dozen swam in front, and a similar number behind. The "djandi" was pulled upstream for about fifty yards, and then the men waded out and struck out for the opposite bank, while every man on either shore who had anything to fire fired it, quite regardless of where the bullets were likely to drop. There were two possible landing-places on the other bank, and of course they tried to make the first and best; failing this, they shot for the second, but if this were missed the party would be carried through the rapids into the deep pool, below which, we were assured, was the rendezvous for luncheon of all the crocodiles in the district. So it was with some perhaps pardonable anxiety that I watched the passage of the "djandi," and with some relief that I saw it hauled up at No. 1 landing-stage.

We took five and a half hours to get our whole party of men, animals, and baggage over, and had no casualties at all, though there were some very narrow shaves, and one mule with his attendant swimmers got carried into the rapids, to be extricated with much difficulty and a vast amount of yelling and shooting. And then we had to climb for some three hours up to the Sens river before we could find a camping-place, as we could not pitch tents on the Abbai; our guides would not stay there owing to fever, and there was no water any nearer. Altogether the day's work had taken us nearly eleven hours, and our caravan was two hours longer *en route;* so that it was almost dark before camp could be pitched on the bend of the river, at this season nearly dry.

Ras Hailu had spared no pains to "make smooth the way for us." Not content with sending a large party to meet us, he had greatly improved the track by removing rocks, improvising bridges, and cutting down trees, so that steep as was the ascent it did not prove as trying as the descent on the other side.

On the next day, January 7, a short three and a half hours' climb up a narrow track brought us to Anjim, a small village, amid a good deal of cultivation, almost at the top of the escarpment. About a quarter of a mile to the west a stream fell some 100 feet down from the cliffs

above us, and the view from here over the Nile valley was very fine, the cliffs of Gudru that we had descended three days before showing faintly in the haze. And by now the character of the country had again changed completely. We had left the arid cotton belt and the stifling heat of the low valley behind us, and once more found ourselves in lovely surroundings, amid dense and luxuriant vegetation, and in a delightful climate.

Our good friend, Gerazmach Desta, who had been detailed by the Governor of Gudru to see us safely into Gojjam, now left us, giving us a sort of patriarchal blessing, and we set off into Gojjam on our way to get as far as we could into that pleasant country. A deputation of priests came out to greet us from the neighbouring large Church of Mariam, and very picturesque they were with their brilliant robes, their brightly coloured parasols, large gilt crosses, and much-decorated religious drums. They spread a carpet for us to sit on, and then danced and sang, a ceremony which I have described previously, and which enables one to visualize what was meant by "David dancing before the Ark." They had not, of course, the "Tabot"—or representation of the Ark of the Covenant—with them, but they had brought a sort of Ikon, a coloured picture cut in relief on wood of the Virgin and Child.

The crosses they use are of all sizes, and are made of brass, of silver or of gold, or of a mixture of some or all of these metals, the brass being obtained by smelting down old cartridge-cases, the silver by melting dollars, and the gold found in the country.

The ride to Debra Markos was through pleasant country, woods, park-land, and cultivation succeeding each other in agreeable variety. We did not, however, come across as many streams as we had in Gudru. Groups of very large trees known as "Chola" were frequent; they were covered with small fruit about the size of cherries, not unpleasant to eat, and flowering shrubs and plants were plentiful.

One difficulty only we encountered, and that was that our small coins—piastres—were of no use, and the dismay of a peasant woman to whom we presented one was quite inexplicable to us at first. The currency here is salt in bars about 18 inches long and 2 inches wide and deep, known as "Amolli," worth about five or six to the dollar—say sixpence each in our money. They are not exactly the most convenient form of small change in the world to carry about, but it is wonderful how long they last: I saw some that were literally black with age and use. This difficulty was however very much minimized by the hospitality we received *en route*, supplies of all sorts coming in at every halting-place.

On January 9 we camped at Ejube (spelt Yedjibe on the map already referred to), a large village of about 1500 inhabitants situated on an open plain near extensive marshes where duck and other wildfowl were plentiful. From here a longish march of over six hours took us into

Debra Markos on January 10, something over 260 miles from Addis Ababa by the route we had come.

We had crossed the mountain of Yobi Mariam some two hours after leaving Ejube, and our route lay along the east of the deep valley of the Chomoga river. The mountains flanking this river run out towards the Abbai into a long spur ending in two flat-topped peaks, Jibela and Mutara, on the summits of which are reputed to be the storehouses of the ruler of Gojjam.

When we were within about one and a half hours of Debra Markos, we saw in the distance lined up across the track a large party of soldiers which we were told was the escort sent out to meet us. Our men now felt that something ought to be done to smarten up our party, so every gun and rifle was requisitioned, and armed with this miscellaneous collection of weapons they formed up by twos and preceded us at a slow march to meet our hosts. These were drawn up by a river, and consisted of about 500 men and three different and independent native bands, which elected to start operations just as our ponies got on to the somewhat primitive bridge over the river. The results were almost disastrous, but we were able to avoid the worst, and hastily dismounting, inspected the guard of honour.

Then in the midst of them, preceded and followed by the bands, we slow-marched into Debra Markos, where the most elaborate preparations had been made for us. Ras Hailu had built for us a zareba about 100 yards square, and in this two new tukuls had been erected, covered inside and out with new white "abougedid." Lines of coloured paper flags hung from posts flanking a matting pathway between them, and near by were four large tents for ourselves and our goods; one of them was nearly 50 feet across, and in another we stabled our six ponies with ease.

The floors of the tukuls and living tents were luxuriously carpeted with Eastern rugs, and a collection of furniture and utensils of all kinds had been put ready for us. Some was European and some Abyssinian; there were native-made "algas" (wooden-framed beds lashed along and across with strips of hide), and divans, and native pottery "gombos" (jars) and dishes, basket tables and receptacles. The hardware (enamel jugs and basins) and some chairs had obviously been imported.

It was really a royal welcome—the escort lined up for us to pass through, and amid a final burst of sound from the "massed bands," we took up our quarters in our new home.

We had not been there an hour before a procession of some thirty or forty men arrived bringing supplies—an ox, some sheep, fowls, eggs, milk, butter, some hundreds of flat loaves of bread in coloured straw baskets, honey, dishes of hot curry stuff, sugar-cane, native-made wax candles, bananas, tomatoes, "gombos" of Tej and talla, barley for the ponies, etc., etc. And finally, amid a brilliant escort of chiefs and

soldiery, Ras Hailu himself came to see us, and gave us the warmest of welcomes.

Gojjam differs markedly from other provinces I have visited, such as, for example, Shoa or Arusi. Arusi is a purely Galla province, conquered in the time of Menelik, and practically the only Abyssinians to be found there are the soldiers and officials attached to the Governor and sub-governors. In Shoa is a mixed population where Abyssinians and Galla have intermingled a great deal by marriage. Gojjam, on the other hand, is a more purely Abyssinian country, the Galla invasion of the fifteenth century from the south having apparently been checked by the Blue Nile and spread east and west. The result is very marked; for one thing, the population is almost entirely Christian, and very proud indeed they are of it. The number of churches is remarkable: in one spot I counted ten of them dotted on neighbouring eminences, each in its grove of trees, and each attended to by a large number of priests and "debtera" living in tukuls round about the church.

Another marked difference was the nature of the cultivation. The population being Abyssinian, they are themselves the farmers, peasants, and cultivators instead of, as in Arusi and other Galla districts, being merely the overlords of the "gabars" (or serfs) who till the land. These latter are treated pretty badly and have to pay heavy taxes in kind, so that their object is not unnaturally to produce little more than is actually required to feed themselves and pay their masters. And it is inadvisable for them to make any show of prosperity. This state of affairs does not obtain in Gojjam, and the country which we saw consequently looks better cultivated, better kept, and more prosperous than in the other districts to which I have referred. Even the cattle are larger than in the south.

The climate also is rather milder than south of the Abbai, though Markos is about the same height (nearly 8000 feet) as Addis Ababa, and the rainfall I understand is not strictly limited to the rainy season. This may also help to account for the greater productiveness of the country.

It seems to be well administered by Ras Hailu, who, though a strong and strict man, takes a keen interest in the agricultural development of his province: he was, for example, bringing water from a great distance to run some flour mills which he was erecting near Debra Markos.

There is much cultivation of a varied character in the districts through which we passed, and the market which is held twice a week at Debra Markos gives one a good idea of the variety of produce which is raised. Our advent in the market-place was, however, the signal for a suspension of business, and in a moment we were surrounded by a crowd of hundreds of people curious to see the "feringis" at close quarters, which made it difficult for us to learn as much as we wished.

The Ras' Government is of course a feudal despotism, and he maintains the old-time traditional hospitality, feeding from 1000 to 3000 people at his "Geburs," or raw-meat banquets, on Sundays and feast

days. He is the last hereditary provincial governor in Abyssinia, his father having been the Negus Tekla Haimanot, a great king and soldier; and consequently his influence and authority in his country are very great. His daughter, the Waizero Sabela Wangel, married the ex-Emperor of Ethiopia, Lej Yasu, and on the deposition of the latter in 1916 she separated from him, and now lives with her father.

Debra Markos itself is not a very striking town; apart from the Ras' palace (surrounded by high walls) and dining-hall, where as many as 3000 people can be seated, the place consists of straw-roofed, mud-walled tukuls; but it is prettily situated, and straggles out over some miles of country. Judging from the crowds assembled for the feasts which are described below, I should estimate the population at from 8000 to 10,000.

We were fortunate enough to arrive there the day before the festivities to commemorate the twenty-fifth anniversary of the death of Negus Tekla Haimanot, and a few days later occurred the great national festival of "Temkat," lasting three days. The old-world religious pageantry on these occasions is very wonderful, and it derives additional splendour from the fact that it takes place out in the open under the blazing sun and in a setting of grand scenery.

The Negus Tekla Haimanot, being an independent king, had his own Abouna or Archbishop—there were three rival abounas in Abyssinia at that time—and both king and prelate are buried in the Church of Markos, built by the former, where the anniversary ceremonies took place.

Externally, the church does not differ very much from the general run of churches in Abyssinia. Unfortunately, I was not able to photograph it owing to its position among thick trees, but the interior was interesting: the walls were covered with Abyssinian paintings depicting every kind of scene from biblical history, some of them distinctly lurid; passages from the life of the late Negus, and portraits of that potentate and of Ras Hailu. Fine rugs covered the floors, and rows of the brilliant headdresses worn by the priests were displayed on shelves near the altar.

The church was as usual divided into an outer gallery, an inner chamber, and the holy of holies, in which is kept the "Tabot," or Ark of the Covenant, containing the Tables of the Law. This again was separated into three parts, dedicated respectively to St. Mark, the Trinity, and the Virgin, each section being covered with appropriate paintings.

We had been escorted to the church by our guard of honour and the three bands, and in the midst of many thousands of soldiers and people, to the accompaniment of the soft throbbing of the big drums beaten with the palm of the hand, and some rather melodious chanting, the strange service proceeded, concluding with a march of the whole enormous throng three times round the outside of the building. A great "gebur"

or raw-meat banquet followed, when over three thousand men were fed in two relays, and at which many curious dishes had to be consumed, and much fiery liquid. And to complete the mediæval effect, stray minstrels dotted about the hall sang songs of praise to the donor of the feast and to his ancestors, accompanying themselves on weird instruments, consisting of a single string stretched along a handle over a sheepskin-covered hollow frame.

A day or two later the feast of the "Temkat," or blessing of the waters, took place, when long picturesque processions from each of the four principal churches brought their Tabot to specially prepared tents by the river to be re-consecrated, the water was blessed, and the assembled thousands nominally re-baptized. Formerly the people used to throw off their clothes and immerse themselves bodily in the blessed waters, and I believe this is still done in some parts of the country. At the feasts I have seen, however, the priests merely sprinkled water on the crowds.

This ceremony lasted three days, of which every phase was absorbingly interesting; it is difficult to say which part of it was the more impressive. Possibly the palm should be awarded to the second day's proceedings, when in a long column ten abreast the thousands of the Ras' soldiers poured down the hill into the plain, the horsemen galloping wildly over the broken ground in their brilliant robes, the dismounted men wrapped in their white "Chamas" clean for the occasion, to meet the priests in their gold-embroidered silk and velvet robes and gilt headdresses with crowns and mitres and croziers grouped around the "Tabots" covered with brilliant cloths, while the incense curled up into the still air under the blazing sun amid a countless throng of worshippers.

The so-called dance of the priests, to which I have already referred, was of course a prominent feature of the celebration; it is unfortunate that a coloured representation of this cannot be given, as it is one of the most curious and picturesque performances that can well be imagined.

There followed the old national sport of "Guks" played by scores of warriors on their active little ponies, armed with shields and light rods. These they threw as spears, riding at each other at full gallop, throwing the rods with extraordinarily good aim, the adversary catching them on his shield with much skill. Their horsemanship was very good, and I noticed that Ras Hailu himself was one of the best shots, his spears getting home with unfailing regularity on his galloping opponent. The dismounted folk indulged in a sort of hockey, and even this is a national and not an imported game. I have found references to it in writings of nearly a hundred years ago.

Altogether our stay at Debra Markos was full of interest, but space will not allow further description. Nor did our time allow us to stay as long as we liked; indeed, we had to curtail our further journey, as the outward trip had taken longer than anticipated. So very reluctantly

we had to embark on the return march to Addis, by a different route, of course, from that by which we had come. Our departure from Markos was quite an imposing affair. Ras Hailu breakfasted with us, and our men felt, I suppose, that they must make as brave a show as possible. Headed by our guide, armed of course with the inevitable rifle, the caravan got into line, and two of our men insisted on leading before us the gaily caparisoned mules covered with scarlet saddle-cloths and silver-mounted bridles which the Ras had given us. He had also given us a very good pony, so that our train of riding and pack animals had become quite a large one, and to this was added the unwilling companionship of an ox and two sheep not eaten yet. Our men had done their best—they had eaten seven oxen and nearly a dozen sheep in seven weeks—but there were limits even to their powers of absorption.

Pride comes before a fall, however, and our triumphal progress did not last long. Our guide led us to a ford across the Chomoga river which lay between fairly high banks, the bed of the river being a mass of muddy bog below the water. The guide's mule got stuck in the bog, and the man himself rolled off into the sticky mess. Man and beast were hauled out with difficulty, whilst we had to crawl ignominiously one by one across a wet and slippery tree-trunk precariously poised on high between bank and bank.

We intended to cross the Abbai above the Muger river just below where the Muga runs into it from the north, and reached this point without difficulty after a pleasant four days' journey through pretty mountainous country, passing the small villages of Inaska on the river Yeda, Gwongi Gabriel on a small stream, and the larger village of Inoanta near the river Baichat.

We camped at Katama, a customs post in the district of Dijen, and it was pleasant to have another look at the great Abbai valley from here, but less so to clamber down its cliffs, though the descent was not to be compared in difficulty with that which we had made previously.

It was however more picturesque, the valley dropping to the river in a series of great terraces, all of which were well and fully cultivated, many villages being scattered about all the way, at one of which, Kurar, we camped about halfway down. We did not again come across the pink quartz-like formation to which I have previously referred, the rock being throughout of a dull blackish-grey right down to the water's edge.

As we were now nearly 100 miles higher up the river than where we had crossed into Gojjam, and above the junctions of the Muger and the Gudir with the Abbai, there was a good deal less water at the crossing (Shifartak, just below the Muga river), and we were able to ford it, though the water came up to the saddle flaps. The crossing was enlivened by much firing of rifles for the benefit of the crocodiles, but it passed without incident.

It was a fairly stiff climb up the other bank, and including the drop-down from Kuror and the crossing, it took some eight hours to reach the halfway village of Badessa, passing through Efila, both unpleasant and dirty collections of huts by muddy half-dried streams, the water of which we had to share with the village cattle and dogs. Our share was largely mud.

A little way up the bank we had come across platforms built in the trees. These, I was told, were observation posts for the soldiers of Ras Kassa, in whose territory we now were, which they occupied when guarding the crossing against "shiftas."

I ought to mention in this connection that the chief of the district on the Gojjam side of the river had been very strongly against our crossing, as he said there was no guard on the other side, as no one knew we were coming. Apparently, when the nagadi caravans cross here once a week, soldiers descend the valley on either side to protect the nagadis against shiftas, and the chief was very anxious for us to await this guard. Of course we refused to do so, for I was, and am, extremely sceptical as to the existence of these folk, and we were fully able to look after ourselves if they had come. It seemed to me to savour more of a desire for baksheesh than anything else.

It is quite true that so-called attacks by shiftas are occasionally reported, but I am inclined to think that they are more often merely quarrels between villagers and the men of the caravan, due perhaps to the leader's ignorance of language and customs, or to unreasonable demands made on the villagers by the men in their leader's name, and of course unknown to him.

We were fortunately able to get a final glimpse of the Abbai from about 1500 feet up. It was a very grand view from there up and down the valley, and one which it had been impossible to obtain on our way north, owing to the different configuration of the valley and the much more precipitous drop.

The valley, which is a good deal wider here, was thickly wooded up to the top of the escarpment, where there is quite a large village—almost a town—called Gwatyor, in which was the Kella, or boundary customs house, of the province of Salale. These kellas are established on the frontiers of every different province, and form one of the greatest obstacles to trade in Abyssinia, as the unhappy nagadi has to pay at each one, and he never knows the extent of his liability until the end of his journey.

From here we followed a route to the east of the Muger river across the high plains of Salale, passing the villages of Garba Guracha, Yaya Aro, and Girar—the last named a largish place on a wide stream of the same name. It was a trying and comparatively uninteresting district, sparsely wooded, where water was not too plentiful, the days hot and the nights bitterly cold. Cattle and horses were to be seen in large numbers, Salale being a noted horse-breeding district.

The monotony was pleasantly varied by the acrobatic performances necessary in the crossing of one or two native-built bridges, which, as I have remarked before, seem to have been built by optimists for optimists.

We did not follow the usual route, but kept to the east towards the big range of Gara Gorfu in order to avoid having to cross the Muger; and soon after crossing a river above some very high falls (about 50 or 60 feet), the name of which I could not discover, we arrived on February 1 at a largish tributary of the Muger, called the Douber, about 45 miles from Addis Ababa.

Here, unfortunately, we met with the accident that marred what had otherwise been a most delightful trip. We had clambered down the steep bank of the river on our mules, a winding track that curled between rocks through masses of scarlet aloes and sweet-scented white jasmine, and had crossed the river by a wide though fairly easy ford through about 1½ feet of water. The mules had, I suppose, had their nerves upset by the dead body of an animal lying across the track, partially devoured by jackals, and just as my wife was preparing to mount, her animal swung round, knocking her down with her foot in the stirrup; and falling sideways, she broke her arm. Fortunately we had a carrying hammock with us, but it was no easy matter for two men to get it up the cliff (there was no room on the narrow track for the full complement of four); and after that we compressed four days' march into two, and across very rough country up the 11,000 feet of the Intotto Mountains and down the other side our men carried her into Addis Ababa, which we reached on the afternoon of February 2, seven weeks to the day from our start. The return route from Debra Markos to Addis which we followed I estimate to be approximately 170 miles.

And here again on the road we met with courtesy and kindness such as I do not think can be very common. Riding behind the hammock I noticed one of the carriers whose face I did not know, and asked who he was. I was told he was just a passer-by who, hearing that a foreign lady had met with an accident, wished to show his sympathy in this practical way by replacing one of our men and helping to carry her. Nor was this an isolated instance, for a little farther on another complete stranger got off his mule, helped to carry for about a quarter of a mile, and gave his mule to one of my tired men to ride meanwhile. This sort of thing happened repeatedly along the route, and I think as an example of courtesy and practical sympathy from complete strangers and men of another race it is hard to beat.

But I am glad to say that my experience of the people while on trek in Abyssinia has always been of the happiest, and so far from getting into trouble with them I have never had even a rude word spoken to me.

In conclusion, I would like to add a few words as to the condition of the country as a whole. In the previous paper which I was privileged

to read before the Society, I gave some reasons which might account for the curious survival of this country in a condition so far behind that of the rest of the world, and amongst the causes I gave an important place to the historical.

A race is necessarily influenced by its history, and by its origin, which in the case of Abyssinia is the subject of many theories. To the theories current in connection therewith, another has now been evolved by a French archæologist, the R. P. Azais, whom we met in Addis Ababa, and who has been carrying out extensive research work for some time in Southern Abyssinia. He has discovered firstly in Harar and then along the Rift Valley towards Lake Rudolph a large number of carved stones and pillars, dolmens, and tumuli, etc. On some of the pillars are carved in relief emblems of the phallic worship, of the rising sun, etc., with hieroglyphic writing and some writing that has not yet been deciphered, but which appears to be pre-hieroglyphic. This is of course of very great interest, and may perhaps establish the existence of a very old civilization in Southern Abyssinia, possibly pre-Egyptian in period.

Be this theory true or otherwise, however, it is clear that in Abyssinia you have to deal with a very ancient race, a fact which necessarily adds to the difficulties of the complicated problem of this the last of the independent Empires of Africa. The contrasts are so glaring: it has one foot in the League of Nations and the other in the Middle Ages. It sends its bargainers to Geneva, and yet some distance from the capital the very name even of the Ruler is unknown.

The great Rases and provincial governors maintain despotic power in their districts—the feudal system exists in all its crudities—the capital is acquiring a veneer of civilization, the country is utterly untouched by it.

The only means of travel are ponies and mules, the only means of communication tracks, and in the rainy season even these are in many cases impassable. And a country as large as Britain, France, Belgium, and Holland put together, possessed of great potential natural wealth, is practically untouched and undeveloped. Some parts of it are practically unknown, hardly any of its people can read or write, and they live as they lived a thousand years and more ago. Slaves are practically an essential in every household, and are held in large numbers by the principal people.

The Regent, Ras Tafari, has a hard task before him in dealing with the feudal elements and age-old prejudices of his people, backed by the power of the Church on the one hand, and the demands of the outside world into which they have been thrust by their admission into the League of Nations on the other: the slavery question alone is an exceedingly thorny one.

What the outcome will be, whether they will themselves succeed in bringing the administration of their country more into line with modern requirements, or whether reaction and ignorance will be too much for those who wish for progress, it is difficult to say.

These are matters, however, with which fortunately we are not concerned, and from a personal and selfish point of view I can only hope that development may not be too rapid in order that it may be possible for us again to wander in some others of the remote and little-known corners of this very remarkable country.

Before the paper the CHAIRMAN (Lord EDWARD GLEICHEN) said: The subject of this evening's paper is "A Recent Journey to Gudru and Gojjam," by Mr. C. F. Rey, who will, of course, tell us exactly where Gudru and Gojjam are. I need hardly, I think, introduce Mr. Rey to you. He gave us a most excellent lecture, also on Abyssinia, four years ago. Mr. Rey has been in Abyssinia a great deal. He went there first of all in 1919 and stayed there for something like eighteen months; got to know the people, and made several journeys from Addis Ababa as a centre. He made another journey in 1922, and has just come back from a third. He has not only travelled much and got to know all the important people in Abyssinia, but he has also —and this is more than most Englishmen have done—learned the language. He knows the people thoroughly, and I think you will have a most interesting lecture.

Mr. Rey then read the paper printed above.

The CHAIRMAN: I am afraid there will be little discussion, because there are very few English people who know Abyssinia. I am tempted to call upon Mrs. Rey to tell us more about her adventures, but I do not quite like to do so. All we can do is to congratulate her most heartily on this very plucky journey and sympathize with her on all the troubles she has been through.

I might say, also, that there is with us this evening a native of Abyssinia who has come over here to study at one of the Universities. I trust that when he goes back he will take with him all the best he can learn in England.

What Mr. Rey has told us this evening brings back most vividly a journey I undertook with a mission many years ago to Addis Ababa, when there were no railways in the country. I was, like Mr. Rey, impressed with the beauty of the country in the mountainous parts, and with the wonderful English type of vegetation—jasmine, honeysuckle, blackberry, myrtle. Along the borders of Somaliland and Abyssinia the country was like parts of Surrey, with a charming climate; not in the least what one would expect to find in the heart of Africa.

I would congratulate Mr. Rey on his photographs. They have shown most vividly the type of country. He told me that the difficulty in Abyssinia was in regard to light, that there is really not half so much genuine light in the country as appears; therefore there is a tendency, in the first instance, to give much too short an exposure. What we have seen to-night shows that Mr. Rey has learned from experience and has produced excellent pictures.

There is one remark I would like to make on the Blue Nile which is of some importance to the future supply of water both for Egypt and the Sudan. It would be of great importance if somebody in the future, anxious for adventure—and I understand some one I know may possibly go—would go and track the Blue Nile from Lake Tana to where it issues into the Sudan. Its course is in great part unexplored. For a large part of the distance it lies in the bottom of deep gorges covered with brushwood, and the current is very

dangerous. The only way would be by boat, but that would be taking your life in your hands, because the river in some places becomes a rushing torrent which may form cascades and rapids of which we know nothing. About twenty years ago Mr. Macmillan tried to do it. He had had no previous experience of Abyssinian rivers, so he tried to do it with two ordinary boats which he took up in sections. Although they were of fair size he had so much baggage and so many people that they were, I think, very much overweighted. He managed to get them on to the Blue Nile and to start. Within three miles one boat was wrecked, and within another half-mile the other went on a rock. The party lost most of their baggage; they got to shore somehow or other, and passed rather a miserable night. In the middle of the night, Mr. Macmillan and the rest of the camp were awakened by appalling shrieks, and they found a man close to Mr. Macmillan's camp had been caught by the leg by a crocodile which was trying to drag him into the river. I need hardly say that that expedition did not last long.

Mr. Rey has referred in conversation with me, but I do not think he mentioned it in the course of his paper, to our scant knowledge of the amount of water that comes down through the Blue Nile. There have been no fewer than three expeditions which have measured and calculated the outflow of water from Lake Tana. They have made calculations for a Regulator Reservoir, and proposed to build a dam, if money was available and Abyssinia agreed. But there is a great deal more water in the Blue Nile when it enters the Sudan than comes out of Lake Tana, and the probabilities are that there are a good many tributaries of which we know nothing. Thus further exploration is vitally necessary. Between Lake Tana and the borders of the Sudan there are no fewer than nine rivers big enough to have their names mentioned on a small-scale map. These are on the left bank of the Blue Nile, and there are five or six more large tributaries on the right bank, besides innumerable small streams.

I will not detain you any further but ask you to join me in a hearty vote of thanks to Mr. Rey for the very interesting and instructive lecture he has given this evening.

HARMONIES OF TONE AND COLOUR IN SCENERY DETERMINED BY LIGHT AND ATMOSPHERE

Vaughan Cornish, D.Sc.

Read at the Afternoon Meeting of the Society, 19 April 1926.

1. Introduction.

IN the course of a tour round the world in 1903 I made notes for a book on scenery to be written later in life, and the material grew during the travels of subsequent years. When Sir Francis Younghusband, in his presidential address of 1920, appealed to the Fellows of the Royal Geographical Society to give more attention to the æsthetic side of their subject, I decided to begin systematic preparation. Throughout the six years which have since elapsed I have kept my attention unremittingly upon the picturesque aspect of things during all my outdoor hours, and have directed my travels so as to fill gaps in this

kind of experience and knowledge. The scientific result has exceeded my most sanguine hopes, for much which I thought could only be described I now find can also be explained, and impressions which I supposed to be merely due to intellectual association, which is personal, I have been able in many cases to trace to the more permanent and general origin of the habits and sensations of the eye. Having found that a rational account can be given of such matters as apparent magnitude, landscape pattern in relation to maximum angle of view, tone and colour, and rhythmic movement, I have abandoned my plan of a regional treatment of scenery, in which these matters have to be mixed up, for treatment according to visual categories in a series of papers each of which is general in the geographical sense, that is to say, comprising the World. In these I attempt, however imperfectly, to provide a scientific foundation for the æsthetic study of Scenery.

2. Concerning the Relief of the Land.

The tones and colours of every landscape go through a cycle of change with the daily and annual revolution of the sun, and it is evident therefore that an æsthetic science of Scenery must give an account of these changes. This requires prolonged study, but as the changes are exactly recurrent the results would be precise were it not that the atmosphere interposes a screen or veil of varying density according to the weather. From the continuous observation of atmospheric effect during the last six years I have arrived at the conclusion that the modes of lighting of the world, taking account both of the position of the sun and the state of the atmosphere, are sufficiently definable to admit of a systematic and fairly simple description and explanation of the variation of tone and colour in the landscape.

When the coast is viewed from on board ship and sunshine bathes the distant shore, the ethereal tone of the land harmonizes with that of the cloud brooding above, and its atmospheric tint never clashes with the dark blue of the deep-sea waves, which roll massively in the foreground. These have great strength of tone, thereby enhancing the ethereal look of the land, which seen thus always seems a place of peace—the "fortunate," or "blessed," land beyond the ocean.

No discordant tint mars the visual harmony of the surrounding sphere as long as the land is distant; but when, on nearer approach, the pasture on the hills shows a green tint, the harmony of colour is generally broken. Among the varieties of greens and blues there are many pairs which clash, and the tint of verdure in the middle distance of the landscape does not blend soothingly nor form a stimulating contrast with a blue sky.

The form of land which gives the best display of atmospheric tones is an indented coast-line of bold relief. On a clear day with detached clouds the incidence of light and shadow often makes a strong, dark

band along the sea horizon. Seen from the beach this skyline is about 3 miles away, and the same brow of the water's visible edge is continued as a strong dark band in front of the successive promontories of the coast. Thus the second, third, and all successive ranges of hill with their several diminished intensities of tone are directly contrasted with the same strong standard tone, that of the comparatively near brow of the water. The view has therefore a stronger articulation of tone than is seen from an inland view-point overlooking successive ridges of hill, each of which is only seen contrasted with its immediate neighbours.

Three varieties of atmospheric condition deal in different ways with an extensive view of lowlands. On fine days, with the exceptionally clear air which often precedes rain, there is a broad foreground of lights, shadows, and local colours. In the far distance the landscape is richly dyed with atmospheric shades of purple and blue. The middle band of relatively unattractive tone and colour is less noticeable, and perhaps actually narrowed. This is the richest daylight harmony of light and landscape in the English Plain. On a misty day the farthest parts of such extensive prospects are shut out and the foreground loses in stereoscopic strength and contrast of light and shadow. The undulations of the middle distance are then revealed in unwonted emphasis by the increased rate of atmospheric absorption, and with an attractive tint of silver-grey. During spells of fine summer weather of anticyclonic type there is no broad harmony of light and landscape in the English Plain. The diffusion of the sun's rays in the upper air deprives the foreground of much of the vitality of tone and colour which are its proper charm and the means whereby it acts as a *distancer* for the rest of the landscape; the farthest undulations of the land lack atmospheric blue, and thin cloud, reflecting a crude white light from the sun, usually makes the sky near the horizon too garish to be viewed together with the distant land.

Turning to the consideration of atmospheric effect in mountain scenery, let us first recall the view from Interlaken, where all the glaciated height of the Jungfrau is seen framed between hills at a distance of about 10 miles. Much detail of rock structure and some detail of glacier structure are seen, but atmospheric tint is noticeable, and has, I think, much to do with the charm of this favourite view. The new-comer to the Alps wishes to push on in order to make a closer inspection, and from less sophisticated surroundings, but the old timer returns with satisfaction to a prospect which has atmospheric tone in all weathers. From the Kleine Scheidegg the summit of the Jungfrau is only $3\frac{1}{4}$ miles distant, measured horizontally on the map, and the view-point is nearly 5000 feet higher than Interlaken, so that on both counts atmospheric absorption is much less. In full summer sunlight the huge prospect of ponderous rock with jutting coigns and sharp edges is extremely harsh and forbidding, but in the milder sunshine of a winter afternoon, with a powdering of

snow on rock faces, the contrasts are sufficiently softened for the view to be pleasing.

In the round of a fine summer day at Grindelwald the Wetterhorn is successively the most beautiful object and the greatest disfigurement of the landscape. At the time of the true, or geographical, sunrise in July the village of Grindelwald lies in the shade of the mountain. From a point such as the Kleine Scheidegg, which is outside the shadowed space, the edge of the shadow can be traced by the track of the sunbeam lighting the motes in the air. From within the shaded area there is nothing to mark the track of the main shadow, but the projecting pinnacles of the mountain crest cast dusky shadows on the sky. These are much better displayed than the "crepuscular rays" from a cloud, which are obscured by the glare of the silver lining. As the sun, climbing behind the mountain, approaches the summit of the ridge near its middle point, the dusky shadows flare out on either hand and each takes the form of a sharply pointed spike, the point not symmetrical but at the extremity of the upper side of the shadow. The whole pattern is that of a stellate, or spiked, crown such as is shown on the coins of some of the later Roman Emperors. The tint of shadowed sky conveys a strong impression of mystery, and the form of the shadows presents a scientific problem of considerable difficulty.

When the sun suddenly rose above the mountain the dusky rays vanished. Half an hour afterwards sunlight streamed down the face of the mountain, but now, the background being dark, the illuminated, not the shaded, spaces were conspicuous, and the appearance was that of bright beams streaming down between the jutting crags, so numerous and covering so broad a front that they were like Niagara translated into light. For about an hour the Eastward view continued to be essentially that of illuminated atmosphere made visible by the mountain. Then followed a time when, with higher sun, there was no longer conspicuous shafting of the shadow and the view was essentially that of a mountain etherealized by atmospheric effect. Seen through some miles of sunlit air backed by a shadowed space, the face of the mountain was uniformly blue. Near the middle of the day the incidence of sunlight made a very different picture of the mountain which, neither flatly shadowed as in the early morning nor flatly lighted as in late afternoon, was lit in such a way that the towers and turrets which surmount its curtain-wall stood out stereoscopically with one face lit and another shadowed. Then for the first time the mountain acquired the look of static strength, "the strength of the hills."

When the blaze of the afternoon sun shone full upon the face of the Wetterhorn, the huge object lost solidity of relief while increasing in solidity of tone, so that it exchanged the nobler for the grosser attributes of rock, appearing less as a tower of strength and more as a burdensome weight laid upon the land.

The culminating peak of the Wetterhorn stands more than 20° above the horizontal line of sight at Grindelwald, so that during the dawn the mountain shut out the saffron band of sky from view. Contrast between the mountain and its background was therefore only that of intrinsic brightness. Parts of the Faulhorn range which are sufficiently near to the direction of sunrise or sunset in July to be backed by the brighter portion of the twilight sky, stand only about 13° to 15° above level, and are seen contrasted with sky which is tinted with warm colour. These eminences, situated at a distance, measured horizontally, of about 3½ to 4 miles, are seen before sunrise and shortly after sunset as a silhouette of startling intensity.

It is remarkable how detail which has been easily seen in the pale blue light of early dawn on a mountain slope in the east vanishes when the saffron glow appears above the ridge. The mountain then takes on the texture of velvet and an intensity of blue-blackness such as the landscape of night never displays. The contrast of the sky-line is far greater than is ever seen by day, for the background is not too bright; and greater than that of moonlight, for complementary difference of colour is added to difference of brightness. But although there is no glare, the occasional flicker of the sky-line shows that the eye is only just able to compass the contrast. No contrast so great is seen at the sky-line of flat land or of the sea where the surface is lighted from all parts of the sky, for it is dependent upon there being a steep slope facing the shadowed part of the sky.

Where the ridge stood up some 13° to 15° above level, as at Grindelwald, the velvet silhouette was of a purple-blue tinge. I have however seen a mountain silhouette which had equal beauty of velvety texture and a finer tint of colour, that of violet verging towards crimson. This was when sailing down the St. Lawrence below the Isle of Orleans early in September, the air being very dry and clear. The sun had just set behind the Laurentian heights, and these eminences, being several miles away and not of great altitude, were backed not by the saffron but the orange band of the western sky. Mountain silhouettes, which are among the most entrancing sights of scenery, are dependent upon great clearness of atmosphere—a fact to be carefully noted on account of the too prevalent assumption that softening of tone by an absorbent atmosphere is necessary for the finest effects of landscape. This is a half-truth masquerading as a generalization. In direct light, particularly when strong, the landscape looks best when toned down by much atmospheric absorption, but when the lighting is indirect or, as in moonshine, direct but not strong, the utmost clearness of air is needed to give sufficient difference of brightness and a complementary contrast of colour. Any hazing of the air when illumination is not strong causes these harmonies to degenerate into monotony.

Distance affects the tone of cloud and mountains in opposite ways.

Mountains, physically compact, look less massive from a distance, being then merely the opaque background of a translucent coloured medium. The cloud, on the contrary, being a sparse collection of small particles, is misty near at hand, but, in its piled-up or cumulus form, appears compact and massive at a distance of a few miles. Hence the disappointment which attended an expedition which I made to Monte Motterone in order to view the distant Alps, including the Monte Rosa group, when great cumulus clouds gathered in the morning sky and hung, apparently, over the distant snowy summits. Nearer at hand in reality than the mountains, they stood out in strong tone, and the spherical modelling of their clustered domes helped to make the scarped forms of the mountains, paled by distance, look comparatively thin and weak. Under these conditions the harmony of land and sky had to be sought by turning away from the mountains and looking south across the plain of Lombardy, where the flat bases of the cumulus clouds lay in a level line parallel to the dim horizon. Each mountainous pyramid of domes was splendid when seen apart from incompatible forms.

At close quarters, where clouds appear vaporous and mountains massive the relation between them is altogether desirable.

3. Concerning Vegetation.

In the treatment of sunshine, timber is unrivalled among scenic features for introducing variety of tone in the foreground by the shadowing of rounded surfaces, and foliage for the reiteration of an ever pleasing contrast of colour, that between the reflected and transmitted tint. Looking at the lattice of the smaller boughs and twigs athwart the sun's rays, the contrast between the two sides of the line of shadowing decreases very rapidly with distance, and the stereoscopic effect is not so much to show objects solidly as to impart a strong impression that three-dimensioned space is a visible reality. The effect is all the more satisfying from its rarity, for the solid mountain shows only faces, the depths of water can seldom be seen, mist emphasizes distance but flattens objects, and the blue sky of a clear day appears as a background to emptiness.

The shadowing of sunlight in the lattice of the woods brings the delicacy of atmospheric tone into the nearer view. The charm of sunlit tracery, so well displayed in bare coppice, is partly that of a play, or liveliness, of light. This is apt to vanish when we look for it, for, once the eye is firmly focussed on any particular pictorial plane of the three-dimensional lattice, the vibrant effect is lost. It can be enjoyed only when we take in our surroundings easily and naturally, and it is perhaps partly for this reason that the source of pleasure eludes general recognition. Much of the delight derived from the play of sunlight in vegetation, particularly overhead and therefore beyond the direct line of sight, is, I think, often ascribed to the climatic stimulus of a fine day.

The transparent lattice of bare boughs in the foreground notably increases the apparent magnitude of a background of buildings, partly by stereoscopic action, partly by contrast of tone. This is one of the scenic advantages of the boulevard, particularly when there is a broad pedestrian alley in the centre. The lattice of the Plane tree is particularly favourable to the effect, as may be seen when looking across the Scaffold site of the Tower of London, or at St. Paul's from the corner of Cheapside. There also one can see how the contrast with sunlit boughs imparts atmospheric blue to a sooty building.

When looking against the light, the tracery of slender boughs is seldom conspicuous by day, for the bright sky laps round. Against the dark background of a snow cloud the delicate tracery of the Birch articulated with many buds, is clearly revealed, but viewed with indifference. Against the saffron or orange band of a fine-weather sunset this tracery of the bare Birch gives one of the most charming effects of our open English winter. We may think of the colour of the sky, or we may think of the form of the tree, but whichever way our thoughts swing they miss the clue to the pleasure, which is essentially connected with contrast between the colour of the sky and the almost unnoticed colour of the boughs. In fact, we often suppose ourselves to be in presence of a single object possessing absolute or independent beauty, when in fact the origin of pleasure is, at the simplest, a dual harmony.

Of the bolder silhouettes of the evening sky that of the Pine tree is pre-eminent in northern latitudes, particularly in the mature specimens with unbranching trunk and tufted top. The closely clustered needles let so little light through that the silhouette begins to be conspicuous before sunset, and, as the clusters of brushes are large, and compact to the edge, the silhouette is still conspicuous after the last glow of orange has faded from the west and the sky has put on the sober livery of late twilight. But no other tree equals the Palm in the boldness of its silhouette, the most distinctive feature of sunset in the Tropics. The long, straight fronds of the great curved leaves, which form the radiating crown of the tall unbranched stem, show in purple slashes against the crimson sky at a distance where the smaller foliage of the Temperate forest would have no visual effect.

The crest-line of a belt of trees has often greater inequalities than that of the boldest mountains, but, when sunshine allows the beauty of local colour to appear, the bright sky showing between the leaves does not permit a neighbouring belt of trees to establish a definite sky-line such as that of mountains or architecture. In the far distance where the foliage appears sufficiently compact, the size of trees is insufficient for boldness, and they do but spoil the outline of the hills, making the ridge either woolly or ragged. But when a belt of deciduous trees in the foreground, lit by the summer sun, is backed by mountains in the blue distance, the foliage appears solid, the outline of domes and spires is compact, and the

contrast of foreground and background in tone and colour is one of the pre-eminent beauties of Scenery.

Of all natural features of the foreground trees are unrivalled as distancers. Looking from between the straight stems of the fir forest, the Alpine valley no longer seems narrow, for the contrast of tone and tint fills the space with atmospheric blue, and the mountain wall looks very lofty in the enhanced distance. So is it also in the view of far-off mountains when trees of slender form or compact foliage, or combining both characters, rise singly from the plain. All who seek the sun of Mediterranean lands in winter know how the Alps are distanced and the plain broadened by the poplar, the cypress, and the round-topped pine standing in the unhedged fields of the Rhône valley or of Lombardy.

To miss nothing of the change of vegetation with change of season is the reward of spending an uninterrupted year in a country home. In Surrey, between the showers of an April day the solid buds upon the trees glisten in the sunshine against the purple background of the passing cloud, but when the buds, unfolding in the warm west wind, spread out in leaves like butterfly wings, the spring sunshine is transmitted, and the foliage has the new beauty of green translucence. Transparency of leaf, and the blending tints which result from it, are so much the special beauty of the foliage in this season that an overcast day is a day spoilt and a wet day a day lost.

After each variety of tree has contributed in turn the highest note of colour and the lustre of translucence, the canopy of the wood no longer draws the eye upwards, the leaves being nearly opaque and all of an inconspicuous tint. But we get great benefit from this thick canopy when we enter the wood on one of those summer days when there is a glare of thin white clouds too strongly lit, for the angle of our outlook on the surrounding sphere is enlarged at the moment when our horizontal outlook narrows. When out in the open the uncomfortable brightness of the sky restricts our gaze mainly to the half of the sphere which lies below the sky-line, but the scenery within a wood is unique in that it is a landscape without a sky-line, and on the most garish day we can look all around as we will.

The foliage of a Surrey heath has more of bracken and gorse than that of a Yorkshire moor, but there is sufficient heather, mostly ling with patches of brighter varieties, to make its purple flower the dominant colour in August. When lit by the sun, the flower is usually inharmonious with the tint of blue which is characteristic of a clear sky in English summer. When the sky of August is overspread with an apparently continuous covering of roll-shaped clouds at a moderate altitude, their deep and quiet tint, inclining towards purple, combines soothingly with the flower of the heather—a harmony of carpet and canopy which gives a broad outlook on the surrounding sphere, and is therefore a recompense for the loss of liveliness of light and shadow. Soon after the flower has

faded, the bracken, which turns colour quickly in the open, takes on strong tints of russet and gold, which make an effective contrast with cloudy sky in early autumn. Looking out over the well-wooded English landscape at this time of year the general scheme of tone and colour in earth and sky is more harmonious under cloud, if this be not too dense, but in the nearer view the sunny day has the advantage in a stimulating contrast where golden leaves are seen high up against the deeper blue, which they make yet deeper by contrast. Within the woods, where the canopy of leaves replaces the canopy of sky, sunlight is always an advantage. Here we find the unusual condition of a landscape best seen at high noon, for "Nature's Cathedral," having no windows in the aisles, must get its light through windows in the roof. When the leaves above are green, gold, and russet, and the bracken spreads gold and russet fronds below, we seem to be plunged in a bath of colour, so completely does the golden glow lap round. The envelopment in harmonious colour is as complete as when sailing on the blue ocean under blue skies, but the character of the spatial rhythm is very different, trunk and bough and shadowed nooks breaking up the stronger elements of colour into smaller spaces, so that the beating of the notes of colour is more rapid and the individual notes less sustained.

By the time that all the leaves have fallen in the wood the bracken on the neighbouring heath has died down, and the tone of the ground is determined by the heather, now of a sombre darkness. There is no clash of tone or colour between this and a dense canopy of winter cloud, but the combination does not deserve the name of harmony, for it is a monotony of gloom. When the sun does shine unclouded in the English winter, the sky is usually too pale to harmonize with the tone of the heather. In the agricultural land of Surrey and the neighbouring counties the prevailing tone of the ground is lighter, and the sere vegetation, which is only autumnal on our trees, but lasts through the winter in the dried grasses of the hedgerow, is mostly of a pale straw tint. This prevailing lightness of tone and tint not only brightens the landscape under winter cloud, but responds to the mild sunshine of the open English winter in a harmony of colour which is of singular delicacy and charm. On fine days the sun, which is low even at noon, shines with subdued splendour in the centre of a wide aureole of pale golden light, whilst the northern sky is of a soft pale blue. Then the lichened trunks and boughs of the hedgerow timber, shadowed by the sun, are tenderly lit in golden light and softly shadowed in atmospheric blue. We find evergreen vegetation in perfect harmony with winter sky in the dry clear air of the French and Italian Riviera. The cypress and olive, the pine and undergrowth of juniper or cistus, dark but strongly lit, harmonize with the unsullied blue, which has such depth of colour that its intrinsic brightness is not felt by the eye. Thus dry, clear air gives a harmony of land and sky when the Earth wears a dark coat.

The pale tones of the English field lose some of their winter beauty in the strong March sun, but one perfect harmony of tree and sky is special to this season when the general response of vegetation lags behind the return of light. This is the picture, perfect in form and colour, of white or pink blossom sunlit on bare boughs and backed by blue sky. No flower of the field has a background so perfect as this uniform expanse of pure colour. It is significant that a small subject precisely delineated upon a large background of uniform colour is a favourite style of pictorial art in Japan, where the blossomings of plum and cherry are national festivals.

Although there are localities where at certain seasons some flower covers the ground with a coloured carpet extending into the distance, the beauty of flowers is generally revealed only when individuals can be distinguished. This being at close quarters, they are not viewed through an atmospheric veil, so that their intrinsic and apparent colours are the same. I have therefore only to note one or two matters relating to the effect of sunlight. The forms of bright flowers, particularly the white, lose in distinctness under a bright sun, and "stand out" better, as the phrase is, in the moderate light of the late afternoon. There is, however, a notable instance in which the lighting of flowers by a high sun is wholly advantageous. At noontide in the Tropics, as I have noticed in Jamaica at the seasons when the sun is vertical, the foliage of the forest looks singularly tame and featureless for want of shadowing. But bright colour is more usual in the flowers of tropical trees than in those of the temperate climate, and when the scarlet blossoms of the flamboyant tree are out, crowning the whole of a great spreading dome, all are lit up by the vertical sun and, being backed by bright green leaves, enliven by contrast of colour a landscape lacking the contrast of light and shadow.

4. Concerning Hoar Frost and Snow, with Remarks on Wind-blown Sand.

The full beauty of hoar frost is admirably displayed by the climate and foliage of Southern England, for here it is repeatedly seen throughout the winter in absence of snow, crusting the delicate tracery of the trees above and outlining the fronds of the bracken below. It forms best where curvature is sharpest (the points of holly leaves carry a whole brush of crystals), so that the delicate tracery of the Birch, articulated by numerous buds, produces the best example of silver filigree shining in the sun against the blue sky. The distribution of snow upon trees is the very reverse, for it only lodges upon a platform, and never rests long unless the platform be steady. Thus it is only in sheltered coppice that bare boughs are loaded to their tips with snow, which, lying thicker where the boughs are broader, tends on the whole to impair the grace of their tapering form. Upon the evergreen pine and fir, however, the snow finds better platforms, and, even while the snow-cloud still broods uniformly grey, the green and white of Pines is a perfect picture of its kind. Thus the Pine is king in the snow as the Birch is queen in the frost.

On days of heavy cloud the beauty of colour in a snowy landscape is confined to the nearer view, or foreground, where local colour tells. Each of these local colours is here contrasted with pure white, a contrast always pleasing except in the case of the lighter greys.

At Glion-sur-Montreux on December 18 the pastures and forest lay dark and sombre beneath the cloud which threatened snow. Dark as that of thunder, but without the purple tinge, it made the waters of the lake below look as dull and inert as lead. In the afternoon the snow began to fall, and the fall continued with short breaks for many days. One morning, when the snow was already deep but still untrodden, I took the road towards Les Avants, which has fine views of the fir forest. There was neither shadow nor blue atmospheric colour, but the snow-cloud was thinning, and the light which came through toned up the grey tints to cheerful harmony. The fall had nearly ceased, but a few flakes wandering slowly down served by the gentleness of their motion to enhance the quiet of silence and the quiet of the scheme of colour. By Christmas Day, just a week after the snowfall began, the cloud had become so thin that from time to time the sun shone through a luminous veil of silvery grey. Up at Caux, beyond a foreground of deep untrodden snow, the silver spires of the forest climbed almost to the clouds, which slowly eddied round the Dent de Jamin, from time to time revealing mistily the summit of the rocky peak, looking far away and immensely high. This harmony of grey and silver was a perfect picture of winter, for nothing but winter was typified; yet the scene was free from gloom. Four days later—eleven after the beginning of snowfall—the canopy of cloud was withdrawn, revealing a sky so uniformly blue that when the sun was covered by the hand outspread at arm's length there was no surrounding aureole of white or golden light. The blue was of more restful colour than that of summer, and had something in common with that soothing tint of twilight which precedes the hue of night. Against this beautiful blue, which seemed to rise vertically from the sky-line, the Rochers de Naye and the rocky mountain wall beyond Les Avants shone white, their rugged surface entirely covered in adhesive snow. Not a point of dark rock could be discerned, yet nothing was lost of the bold angular form proper to a rocky mountain, for though the rock was coated it was not swathed in snow. This wonderful sight did not endure for a second day, for the snow soon began to slide in avalanches, and the rock appeared. In the fine days which followed, the most varied and wonderful harmony of tone and colour in this neighbourhood was not to be found in the clear air of the high mountains, but on the frozen marshes at the head of the Lake of Geneva between Villeneuve and the mouth of the Rhône. Here was delicate contrast of warm and cool tints in the great beds of yellow reeds and the calm surface of pale blue water, and light and shadow conformed to this, for the *brouillard* from the lake, hanging overhead more transparent than a cloud, tinted and softened the rays

of a sun which at the level of Caux must have shone with intense colourless light. Thus each tree-trunk was warmly lit and coolly shadowed, whilst the poplars and other tall stems, strongly toned in the stereoscopic foreground, distanced and etherealized the background of the Savoy Alps with their rhythmical sky-line of rocky peaks. Next day the contrast of warm lighting and cool shadowing was maintained, and indeed somewhat strengthened, but the mist, being lower, shut out the view of the noble mountains. Yet the joy of the previous day returned. On the third morning there was no translucent *brouillard* overhead, the rays of the sun shone colourless on the trees and snow, the reflection from white cirrus cloud which covered a large part of the sky took all colour out of the shadows on the snow, and my mind swung back from poetic to prosaic mood, although the mountains that I loved had been restored to view.

The harmony of colour on the first and second day resembled the harmony of greys on the last day of the snowfall in so far as the tints were pale and not strongly contrasted. Why, then, did one seem to be in presence of a higher order of beauty? I infer that this was due to the introduction of a harmonious tone and tint from the stimulating half of the spectrum. As a matter of fact, the tints were not very different from those of the two nearest wave-lengths which will combine to give colourless light, but I am not sure whether this fact is significant.

At Wengen, in the settled fine weather of middle January, there was no repetition of the spectacle of a mountain of shining silver backed by a curtain of blue which I had seen in December at Caux. The fir forest, too, had shed its silver coat. The particular beauty of colouring was in the shadows of the foreground, which, during all the hours when the sun was above the mountains, were of a violet-tinted blue. Only when it happened that the eye was overtaxed by surrounding light was this colour in any way masked; whenever one was so situated as to be shielded from glare, the strength and definiteness of the colour were such that one felt inclined to change the description of the appearance, and to call it "a reflection" instead of "a shadow." Day after day in the cloudless dawn the surrounding peaks lay in blue shade, excepting one, the Lauterbrünnen Breithorn, which, catching the level rays of the sun, flushed rosy pink, the snow responding to the colour of the light. But it is in the winter landscape of the plains, not of shut-in Alpine valleys, that snow gives the subtlest rendering of the tints of the sky. In the pale golden light of the later afternoon the little inequalities of surface, which generally develop after the snow has lain some time in the open, bring together on their opposite slopes the warm and cool tints of the western and eastern sky. That contrast, which in the sky itself is spread almost too broadly for the compass of the eye, is here rendered rhythmically in a small repeating pattern. The finest example of rhythmic reflection in snow which I have ever seen at sunset was under a clear sky on the open and

lofty plateau of the Jura around Pontarlier. The undulating ground swathed in snow was as it were in gentle billows of dull crimson and sober purple.

Who that has seen snow only in its winter beauty would suppose that in summer in the high mountains, after a fresh fall, the prospect is intolerable, a mere blinding glare of crude white, the light being too strong to recognize colour in the foreground? But far away beyond the snow-field the snowy summits on the opposite side of the valley, toned by distance, are even then made beautiful by atmospheric colour.

The dune-tracts of the desert resemble the snow-field in being composed of a single material which is monochromatic and has a smooth but matt surface, not giving a mirrored reflection as water. The reflection from the sandy desert is so strong that it colours the clouds. I well remember that my first glimpse of desert colouring was on a voyage from Naples to Port Said while the low coast of Egypt was below the horizon, but dappled clouds hanging over the invisible country glowed with the hot colour of the tawny sand.

In the dune-tracts the glare of the burning sand is unbearable in the mid-day sun, and in the late afternoon the atmosphere is often hazed by sand or dust suspended in the air. Accordingly the full beauty of this landscape is soon after sunrise, when the air is of Alpine clearness. On the route between El Qantara on the Suez Canal and El Arish, where I saw the effect, the steeper sides faced west, and their deep blue shadow contrasted with the pale gold of the sunlit slopes. The sinuous ridges, sharp as those of crystalline rock but smooth as the crest of a snow-drift, culminated in pyramids which stood out in a bold contrast of colour against the sky, apparent mountains. This is one of the cases in which the beauty of a landscape is not dependent upon an atmospheric veil but upon the unveiling effect of clear air.

5. Concerning Water.

In ponds and lakelets with wooded banks the reflection of foliage surpasses the original in texture, and the diminished brightness of the sky in reflection enhances the contrasts of tone and colour by taking away glare. One sunny day when noticing the superiority of the autumn colouring in a large wayside pond to that of the foliage of trees and bushes on the banks, I considered whether there were not something besides surface lustre and intensification of tone which contributed to this superiority, and I found it in the fact that the whole of the reflection had the appearance of being in one pictorial plane, whereas the trees and shrubs themselves were seen stereoscopically, which distracts the eye from the appreciation of colour.*

* See 'Notes on the Science of Picture Making,' by Sir Charles J. Holmes, Kt., p. 129, on Chinese and Japanese painting, which secures maximum effect of colour by abolishing relief.

Although the eye can convey information on many subjects at once, it has a difficulty in contributing to more than one kind of feeling at a time, and for this reason the charm of landscape is more often impaired by incongruities than by lack of variety.

As the size of the sheet of water is increased, the spectacle of a landscape clearly mirrored in the depths becomes more impressive; but it is more uncommon for several reasons. Only among mountains does the opposite shore of a considerable lake stand sufficiently high, and those lakes which are fed by glacier streams are lacking in clearness, as Wordsworth pointed out in his 'Guide through the English Lakes.' Lastly, the larger the body of water the less often is it free from waves, the ocean itself never providing a flat mirror. The best example of a mirrored landscape which I have seen was at the upper end of Ullswater, looking across towards Place Fell. The season was late September, when woods and fells were already showing autumnal tints. The time was early morning, the sun was shining brightly, and the leaves hung motionless in air of absolute stillness. The wooded islands were accurately mirrored, and the rocky shore-line opposite was the axis of symmetry in the double view of an upstanding and inverted mountain. A catspaw of wind, which did not reach the shore, touched the middle of the lake, when the reflection of each tree was drawn out and at the same time articulated by fine transverse stripes. It seemed as if the rare spectacle of undisturbed, deep-seated reflection on a large scale was over, when, without apparent cause, the drawn-out images closed up and the landscape was once again mirrored in true form and with enrichment of colour and texture. Thus while the world above seemed to have abandoned the habit of change, standing still and silent in the mellow sunshine, the mirrored foliage was mysteriously changing, a magic scene in which beauty came and went as at the touch of an enchanter's wand. Watch these subtle changes for long and work-a-day thoughts are put to sleep, whilst the mind makes wonderful excursions on the wings of imagination!

A lake mirrors the colour of cloud and sky, and undulating country displays atmospheric absorption by a succession of different tones. The heaving ocean performs neither of these feats but responds in another way to the state of the sky. If the sky be wholly clear or uniformly clouded, the whole broad expanse of water takes a concordant tint of the same class of colour. Beyond shallow soundings, the water, unsullied by sediment, is penetrated by the sunlight, and the combined result of superficial and deep-seated reflection is the deepest blue that is ever seen on a large scale in Nature. When the breeze is blowing, and white clouds drift across the blue sky above, the "white horses" of the foaming waves chase across the deeper blue of the sea below. Should the sky become overcast the sea at once is sad. Then let a rift, however small,

open in the clouds, and a glittering patch of silver on the sea immediately brightens the scene.

The waves, which prevent the shape of the clouds from being mirrored, are themselves heliographic mirrors. Thus the scene from the shore, with its instantaneous response to every change of sun and cloud, seems wonderfully varied to the stranger, yet it lacks the variety of a longer rhythm such as that with which the colour of vegetation registers the round of the year.

When the sun is rising from the clear and dark horizon of the sea the reflection is almost entirely in the line of the sun's direction, and the ribbed surface of waves draws out the reflection in a lane of crimson light which contrasts harmoniously with the steely blue of the surrounding water. As the sun climbs, the manner of reflection changes and flashing points are scattered widely over the watery plain. The flashes multiply when the sea breeze gets up and sends little waves dancing across the ocean swell. This "laughter of the waves" is an unfailing delight of both winter and summer morning in our latitude, but where the sun is overhead and the Trade Wind blowing strong the glitter of the sea is almost unbearable, and visibility is restricted by excess of light. The features of Scenery are never so completely obliterated in the dimness of night as when reflecting or transmitting the blinding light of the sun. I have known a ship with sails fully spread, and scarcely more than a mile away, disappear completely in the broad sun-streak on the water. In moonlight, on the contrary, a fishing fleet, sailing unnoticed against dark water, is suddenly revealed in a silhouette of extraordinary strength of tone the moment that it enters the moonstreak on the waves. There are, however, places and conditions in which the power of the overhead sun and the steepness of the rays call up beauties of tone and tint in the water which are not seen in high latitudes. On the shore of Barbados, looking out to sea, the more distant waters are of deepest ultramarine. Nearer at hand the waves run in white foam over the barrier reef. Within the line of the reef, where clean coral sand covers the bottom, the vertical rays of the sun, scarcely reflected at the surface, penetrate the clear water, strike on the sand, and, reflected upwards, impart to the liquid the lustre as well as colour of a green-tinted aquamarine. I do not know where else the *gleam* of water is seen on so large a scale as in the lagoon within a coral reef; but I have seen the effect very beautifully on a smaller scale where the waves of the deep Mediterranean come in upon the rocks of Cap Martin, and the low but bright winter sun shines through the green translucence of the curling breaker.

It happens sometimes, although rarely, on a voyage that the colours of sunset are repeated in the water. The sky is best mirrored where there is no ripple, and also, I think, when there is sufficient sediment in suspension to make reflection mainly superficial. It was once my good fortune to be anchored out in the land-locked Gulf of Paria at sunset in

the wet season. The usual afternoon thunderstorm had passed, and the air was still. The water, which contains sediment from continental rivers, was unruffled but heaved with a gentle swell. The sky was scattered over with large clouds widely detached from one another. As the sun went down these flushed in all quarters with every shade of crimson, the waters caught the glow and the ship was surrounded by lapping crimson waves, while the hills of Trinidad and the land of Venezuela, encircling the horizon, divided the upper from the lower flame by a band of deepest purple.

6. Concerning Fog, Aurora, Cloud, and Clear Sky.

Once immersed in the cloud which clings to the mountain, or in that, called "fog," which settles on the plain, the thing is no longer an outlined object but an atmospheric medium of capricious character, obliterating the distant view yet imparting great sense of distance to nearer objects, now wrapping the world in gloom, now diffusing the sunlight so as to make "a cheerful atmosphere" without revealing facts.

Morning mist broods motionless in the days when summer is passing into autumn. Moving creatures are seen as ghosts looming up suddenly from the void and quickly vanishing. Then, as the climbing sun sends down a warmer ray, the fog disperses and there is a sudden transformation to sparkling light, for on every blade and leaf the mist-drops flash. On the close-cut lawn they shine as steadily as planets, where pendant on the points of long grasses they twinkle like the stars, with the colours of diamond, emerald, and topaz. On the spiders' webs which hang upon the gorse the drops are smaller, resembling seed pearls, uniformly strung along each thread, the tighter the thread the smaller the pearl, and with a larger pearl at every knot.

Although the forcing of atmospheric perspective by fog increases the apparent size of nearer objects, the natural landscape often loses more than it gains in this respect owing to the total obliteration of the distant view. In cities, on the contrary, the arrangement of scenic features cooperates with the forced perspective of fog, for the buildings stand as high as mountains above the line of sight, and are ranged at short distances from one another. Travelling up to London on a foggy winter morning one misses the accustomed expanse of the country view, but finds in Parliament Square and among the museums of South Kensington façades stretching away with unwonted stateliness of length, from which towers rise to heights matched only by the enchanted palaces of a fairy tale!

The sky-line is the pivot of Scenery, the general character of the view being broadly determined by the relation between all that is respectively above and below. Consequently the tone and colour of the sky and cloud have been partly treated incidentally in the preceding sections of the present paper which deal with Land and Water. It remains to speak

of certain harmonies of tone and colour above the sky-line which from time to time claim and secure undivided attention.

On 6 Septemter 1924, being in the northern branch of the Gulf of St. Lawrence eastward bound, the sky was visited by the mysterious Aurora. The moon set early in the night, the sky was almost free from cloud, and the atmosphere sufficiently clear for the constellations to be seen with a fairly full complement of stars. At a quarter-past nine the Aurora, which had a slightly yellow tinge, was a low arch of light, centred beneath the Pole Star, as well as could be judged by eye, and spanning about 60° of the horizon. The arch grew in height hour by hour, rising above the Pole Star before eleven o'clock, and touching the zenith by midnight. The most brilliant parts were at either end of the spring of the arch, a little north of east and a little north of west, as well as I could determine. Between this zenithal arch and the north horizon was a second arch culminating between the Pole Star and the Great Bear, then approaching the meridian in the lower part of its path. The interspaces of sky not only appeared very dark, but lacking in the ordinary blue tint, and might have been mistaken for thin cloud but for the presence of stars. The seven stars of the Great Bear stood in such a cavity of untinted darkness, below which were the most striking forms of the Aurora. These were clustered shafts of light occupying quite 50° of the horizon, standing upright, some straight, some bent, always pointed. The auroral display was not confined to the northern half of the visible hemisphere of sky, for long bands of light stretched across the constellations south of the zenithal arch, one of which reached along the horizon from east to nearly south. Thus the auroral glow extended to nearly three-quarters of the circuit of the horizon. The scene was continuously changing, but subtly, for the bands did not sweep across the sky, and there was no movement that could be watched. Although the Aurora had the appearance of a veil the stars shone clearly through it. Indeed, the Aurora beyond all other appearances in Natural Scenery conveys a sense of mystery. In the stars we see other Worlds separated from our own; the Aurora conveys the impression, which may well be a correct impression, of a visitation from other Worlds and the presence on Earth of something unearthly.

In the east before sunrise and the west after sunset, an unclouded sky shows bands of colour arranged in order of refrangibility from below upwards, physically horizontal but slightly arched by perspective. The chromatic banding is enhanced by the layered structure which is normal in the lower atmosphere wherever there is haze, smoke, or mist. The band of twilight colour is broadly spread, and exercises a calming influence, very different from the exciting effect of the narrow rainbow. The calm effect of the twilight bands, as has been pointed out to me, is

probably enhanced by their horizontality, the horizontal line being the easiest for the eye to deal with.

The bands appear longer, narrower, and more distinct, and new transitional tints are often revealed, if we look with the head held nearly horizontally instead of upright. The same effect is obtained if an attitude be assumed which places the head upside down. The latter position is of course incompatible with comfortable observation, but to lie on the side and look at the horizon is comfortable and even luxurious, and this mode of viewing not only enables the effects of refraction to be seen in greater detail, but reveals more clearly the layered structure of the air, to which I have referred. It is well known that lines which are vertical in the plane of the picture, whether physically upright or receding, are exaggerated relatively to those which run from right to left, and that this is due to customary associations. I suggest that when an unaccustomed position is adopted the fetters of custom are broken, with the result that horizontal bands are narrowed, and the contrast of their colours consequently increased by juxtaposition, just as colours are enhanced in the charming miniature of a room reflected in the old-fashioned convex mirror. It might be worth experimenting with a diminishing glass to see if broad and nebulous appearances in the sky can be made more evident.

When the sun is fully up the reflection from clouds is too bright for steady gazing except in the case of those near the horizon, and on this account the upwelling movements, so dynamic in appearance, in the masses of growing cumulus are little noticed. The perfect shadowing of the clustered domes can however be comfortably viewed towards the end of the afternoon, by which time the cloud has attained its final development. A spherical surface is, of course, the best form for displaying gradation of tone, and not even the foliage of oak or elm equals the cumulus in this treatment of light.

When the sun shines through wispy cirrus or from a "flock" of dappled cloud, a cone of 60°, more or less, is practically invisible owing to blinding glare. When the full moon shines in a dappled sky the contrary effect is produced, the luminary being the centre which the eye seeks, and the surrounding circle of 30° radius, or thereabouts, is the best part of the sky view. The difference of tone between the cloud and its background is much stronger than by day, and colour is often added by a prismatic halo. The swift procession of storm-driven clouds is also best displayed when the hurrying masses alternately eclipse and disclose the moon.

It happens that the exciting kinds of colour only come into the sky when the light of the sun is so reduced that the eye can welcome pink or crimson reflection. At Camberley, Surrey, a pink reflection is first seen about a quarter of an hour before sunset, deepening until sunset, when the clouds in the east are, under favourable conditions, dyed with

rich and brilliant carmine. This is backed by a sky of more sober blue than that of full daylight. After sunset the reflection from the clouds deepens in tint and diminishes in brightness, until, about a quarter of an hour after the disappearance of the sun, the deep, dull crimson fades out altogether. The acme of beauty of evening clouds is found in those rather low down in the western sky which transmit the sunlight and glow as gems with colour in their depths. There are calm evenings when, in the neighbourhood of the western horizon, a vast concourse of detached clouds, crowded by perspective and elongated by the same cause but otherwise irregular, changes its pattern of lustre and colour from minute to minute, almost from second to second, immediately after the setting of the sun. This mysterious transformation unaccompanied by movement is, I believe, the most deeply emotional aspect of glowing colour in the whole range of Natural Scenery. There follows that peaceful time when the twilight sky is intermediate in tint between the bright blue of day and the almost invisible hue of night, a phase which often appears in the devotional pictures of the Italian schools. The colour verges on violet, and consequently the moon, which is pearly white by day and silvery by night, takes on a golden tint.

As night comes on the scene becomes monochromatic, and, when the moon is absent, the land becomes almost a monotone so that there is nothing to distract attention from the sparkling pattern of the stars.

Before the paper the CHAIRMAN (Col. Sir CHARLES CLOSE, Vice-President) said: This afternoon we are to have the pleasure of listening to a paper by Dr. Vaughan Cornish on "Harmonies of Tone and Colour in Scenery," which follows very well on the paper he read before the British Association at Southampton, in September 1925, entitled "Subjective Variations in Magnitude in Natural Scenery." Dr. Vaughan Cornish has, for some years, studied the effects on eye and mind of the varying aspects of the natural phenomena of the Earth's surface. The class of study, which I believe is comparatively new to this Society, received a notable stimulus from Sir Francis Younghusband in 1920, and again last year at the International Geographical Congress at Cairo, when Sir Francis read a paper on "Art in Geography." Dr. Vaughan Cornish is, as we all know, a Doctor of Science, and we find in his studies science and art joining hands. We look forward to learning from him the reasons for our enjoyment of some of the aspects of nature. I will now call upon him to read his paper.

Dr. Vaughan Cornish then read the paper printed above, and a discussion followed.

The CHAIRMAN: Sir Francis Younghusband has sent a note which I will ask Mr. Hinks to read.

Mr. HINKS: Sir Francis Younghusband wrote from Baveno: "I am so glad you sent me Dr. Cornish's paper. I think it most valuable," and he asks that the following note might be read:

"Dr. Vaughan Cornish is striking out on a line which ought to have valuable results for geographers. It will help them both to observe and to describe natural beauty. It so happens that his paper reached me on the

morning I was leaving for Lago Maggiore, where I am writing this note. Now, like thousands of others, I have come here because of the natural beauty of this region. At the head of the lake is Locarno, and the reason it was chosen for the meeting-place of the Ministers was its natural beauty. That gave a good setting for the meeting; and also there were plenty of hotels in the place, because the natural beauty attracted so many travellers to it.

"Natural beauty is, therefore, esteemed of great value to a place. And if this is so geographers ought to be in a position to describe it and should make it their duty to do so. But in this delicate matter of observing and describing they need guidance and instruction. Often all they are able to do is to say that they saw a 'most magnificent mountain' or 'a perfectly lovely lake' and leave it at that. Dr. Vaughan Cornish will, however, enable geographers to see and to say wherein the beauty of a place lies, and will enable us to compare the beauty of one place with another.

"Take as an example the matter of atmosphere. That alone needs careful observation and description, for it may make the greatest difference to the beauty of a place. Incited thereto by Dr. Cornish's paper, I have been observing the atmosphere here on Lago Maggiore. It is a brilliantly fine day. There is not a cloud in the sky and a haze is over the whole scene. But this haze is almost colourless compared with the deep violet haze of Darjeeling or the bluey haze of Kashmir, or with that most beautiful haze of the Isle of Skye. Of course, this haze here is not really colourless, but it is in comparison with these others, and in consequence the mountain sides have not to-day—though they might after rain—that velvety Persian carpet appearance that one remembers so well seeing in parts of the Himalaya.

"Then again as regards clearness of the atmosphere: in the Himalaya, and especially beyond the Himalaya in Tibet, there is a clearness which often detracts from the beauty by destroying the perspective—everything seems at the same distance. And as regards the blueness of sky, this Italian lake sky is almost pale beside a Tibetan sky, owing of course to the fact that here we are only about 600 feet above sea-level, whereas the Tibetan plateau is 14,000 feet.

"I much hope that in the next edition of 'Hints to Travellers' there may be a chapter written on the lines of Dr. Cornish's paper, which will help a traveller to observe natural beauty with care and thought and to describe it in such a way that others may be able to see what he has seen and to share his enjoyment. This I believe to be a very important part of geography."

Dr. H. R. MILL: I welcome this paper by Dr. Cornish, because I think it is good to call people's attention back to the impression that natural scenery makes upon the mind. In the eighteenth century that was practically the only point of view that appealed to the sentimental travellers of those days, and the old guide-books to the Lake District, written about the middle of the eighteenth century, rather amuse one, suggesting that the one idea created by Borrowdaile was that of horror at the grim darkness of the rocky recesses clothed with shaggy woods, while the smiling beauty of the plain about Keswick is called upon to counteract the dangerous effects of the extreme ruggedness of the dale.

In those days it was customary for the guide-books to be illustrated by maps, and it used to be stated, no doubt with pride, on the title-pages of some that the maps showed "all the stations." The stations in those days were not what we call stations, because it was before railways were thought of; they were stations chosen by specially qualified lovers of natural beauty from which to evoke the proper sentiments that should be produced by the scenery there spread before the eye. I think it is something of that sort that Sir Francis

Younghusband wants to bring back. The only difficulty that seems to me to stand in the way of it is, that while the description of scenery in terms of the form and material of the land is capable of precise expression and will hold good for any observer, the æsthetic effect of the scenery upon the mind must necessarily depend not only upon the training in observation of the eye but on the æsthetic perception of the mind of the person who looks upon it. Therefore we can hardly hope to find the same impression produced on different people by the same natural phenomena.

I did, however, greatly appreciate the extraordinarily fine choice and precision of language in which Dr. Cornish described those very difficult and evanescent phenomena of colour. Colours, especially the colours reflected by snow in the Polar regions, have struck every traveller in those parts, and those who remember the description of colour in 'The Home of the Blizzard' will have some idea of the extraordinary brilliance and the great variety of those effects. But it requires a trained and carefully educated mind to describe them in such a way as to make any comparison possible between one region and another. Those of you who have read F. A. Cook's 'Attainment of the Pole' will remember the fervid language in which he holds forth page after page on the marvellous colours which he saw upon the snow in the Arctic summer, a description more like the dream of a morphia-maniac than the quiet and scientific survey which Dr. Vaughan Cornish has given to the quieter phenomena as seen in the Swiss Alps.

One or two points in the paper struck me forcibly, the first being the effect of reflections in clarifying and giving precision to the view. It is an effect which I had myself observed, but I put it down to defects in my own vision. The occasion when I saw it most prominently was when going along a crowded street, the traffic in which seemed a confused blurr of moving vehicles and people. On looking into the window of a jeweller's shop, which was backed by a black curtain exhibiting certain precious stones, I saw the street reflected in the black mirror with absolute sharpness and clearness of detail. I put it down to an effect of polarization of the light, and it may be that is the explanation of the clear effect of reflection in perfectly still water. It may, on the other hand, be that Dr. Cornish's explanation of seeing the whole picture in one plane is the actual solution; either way it is a point worthy of further study.

I should have liked if Dr. Cornish had said something of the colours due to abnormal refraction and to the peculiarly weird effects that are produced not only in form but in the blending of soft colours by the autumn mirage so often on the coast of our own islands. I have seen, for example, the north of Ireland lifted right up into the sky with ships sailing beneath it. The colour background, which is not sky or sea, has an extraordinarily bewildering or magical effect upon the mind. In fact, all along the coast of Ireland and the west of Scotland, especially in the Isle of Skye, to which Sir Francis Younghusband referred, the sunset views have a translucency, a clearness, a gem-like quality that I have never seen in any other part of the world. No doubt it may be explained, or at least to some extent accounted for, by the degree of humidity in the atmosphere and the transparency of the dust-free air, but the effect is so peculiar and so characteristic of the place that I think it largely accounts for the mystical outlook of the Celtic peoples dwelling in the Far West. In fact, the whole subject, as treated by Dr. Cornish, seems to me to supply a valuable nexus between geography and poetry. As he read his paper, quotations from the poets came to my mind one after another, describing effects similar to those which he had observed; describing them purely from the emotional point of

view, while Dr. Cornish dealt with them from the point of view of precise scientific description.

I have to thank Dr. Cornish very much for giving me a real treat in this paper, and I hope that it will have the effect of doing away with some of the hardness of outlook which was, perhaps, characteristic of Victorian men of science, but which is now abating as we are beginning to recognize a psychical element superimposed upon the physical, which perhaps gives us a nearer approach to the solid truth of things than was open to our immediate precursors.

The CHAIRMAN: If no one else wishes to make any remarks I will ask Dr. Cornish to reply to the points that have been raised.

Dr. VAUGHAN CORNISH: I was extremely glad to hear the letter from Sir Francis Younghusband. In the paper I have acknowledged the stimulus of his first presidential address, in which he urged geographers to pay more attention to the æsthetic side of their subject.

Dr. H. R. Mill's comments are always interesting and suggestive. I noticed that he is well acquainted, better than I am myself, with the early literature of the study of scenery in the English Lakes. I have however read some of it, and I was extremely interested when I first looked into Wordsworth's prose 'Guide Through the English Lakes,' for it was the first book dealing with scenery in which I found anything in common with my point of view. All the books bearing a title connected with scenery which I had consulted dealt entirely with the physics of scenery and not at all with the æsthetics. They were, from the æsthetic point of view, entirely unscientific, these writers not understanding what were the problems to be solved, much less how to solve them. I found, when reading Wordsworth in prose, that he was a very diligent pedestrian, who went about trying to understand why the things which gave him pleasure did give him pleasure. He worked scientifically at the æsthetics of the neighbourhood in which he lived, and we are now carrying on the study from about the point where he left it.

The important point raised by Dr. Mill as to how far the impressions upon one person are peculiar to that person, troubled me when I started systematically on this investigation six years ago. I decided before committing my views to print that I would try them on a class, and a course of University Extension lectures was accordingly arranged. These were attended by educated people, most of whom had been used to travel. There was a discussion after the lectures, and I made sure from these discussions that the way in which I viewed and appreciated scenery was not peculiar to myself. In fact, the longer I go on with the subject the more strongly is the conclusion forced upon me that these impressions are more general than has been supposed; that they have less to do with intellectual associations and more with the nature and the habits of the eye than is usually thought, and therefore that they are of more general value.

The first explanation of an impression received is always connected with the conscious mind, but this reverses the order in which impressions are received. The effect upon the eye is much quicker than the effect upon the mind, and the view generally induces a feeling before you have time to think. A great deal is due to what may be called the personality of the eye; which works with pleasure or discomfort according to the character of the work which it is set. Beauties of scenery which are really due to conscious associations, I hope to treat in a separate paper when I have cleared the ground by going through those which are strictly visual.

With regard to the question of reflection and its superiority as a colour

picture; I have not considered the question of polarization, but as to the superiority of a colour picture in the single pictorial plane I would refer to the remarks in the extraordinarily suggestive book called 'Notes on the Science of Picture-making,' by Sir Charles Holmes, the Director of the National Gallery, who points out that in the Chinese and the Japanese paintings there is only a very slight suggestion of relief. It is largely for this reason that the colour is so effective. The artists of the Far East adopt the principle of one harmony at a time.

The CHAIRMAN: We have listened to a very suggestive and poetical lecture. Dr. Cornish is trying to disentangle the objective from the subjective in our appreciation of natural scenery. It is a very difficult task, and we wish him good luck in it. He certainly has expressed himself in a most admirable way in the series of pictures which he has brought before us, and it is delightful to have listened to him. In your name I thank him for his interesting, poetical, and instructive lecture.

THE BOTLETLE RIVER

E. H. L. Schwarz, Rhodes University College

IN June 1925 the Irrigation Department of the Union of South Africa sent up a reconnaissance party to the junction of the Chobe and Zambezi rivers, and invited me to join it. After spending a short while in camp, and finding there was very little for me to do, I went off on my own account, first to the Katima Molilo falls on the Zambezi, to study the nature of the western rim of the Greater Ngami Depression, then to lake Ngami; from here I went down the Botletle, across the northern Kalahari to Serowe, and so to the railway at Palapye Road. Owing to the heavy rains in 1924, and the flood of 1925 coming down before the water of the previous year had cleared away, there was an unusual congestion in the swamps of the Zambezi, Chobe, and Okavango rivers. The Tamalakane, which collects the surplus on the south, was so full that it forced the water right into lake Ngami on the one hand, and into lake Kumadow on the other. Neither of these have been studied in a flooded condition, and indeed lake Kumadow was passing into oblivion, so the chance that brought me to the region at the height of the inundation was peculiarly fortunate.

The Botletle flows in a deep channel in Kalahari limestone. From the many right-angle turns, and the discovery that the Botletle Beds, or quartzites underlying the Kalahari limestone, are faulted in directions parallel to these bends, it is reasonable to conclude that the river-course has been determined by faulting, in much the same way that the Blue Nile has after it issues from lake Tana. There are many factors going to show that these faults are of very recent date.

According to Capt. Stigand, before 1760 the southernmost branch of the Okavango, the Tsau, flowed straight through the flat depression

where the lake afterwards formed, and up the Ngami river to its junction with the Tamalakane, and then down the Botletle to lake Kumadow. The natives told Oswell in 1849 that lake Ngami was called Noka ea Batlatli, and Andersson records the fact that it was called Noka ea Botletle. *Noka* is a river, and the Botletle are the Bushmen who live in lake Kumadow, so the name seems to perpetuate the memory of the conditions when there was a current from Ngami to Kumadow. Chapman states it was probably so thirty years before he was there in 1863, and there is nothing impossible in such a condition of affairs. It is true there are now three barriers of quartzite constituting steps over which the river runs towards lake Ngami in rapids, but there are signs that there may have been a recent uplift in the region where the Tamalakane, Botletle and Ngami rivers come together. The total fall of these rapids would be about 25 feet.

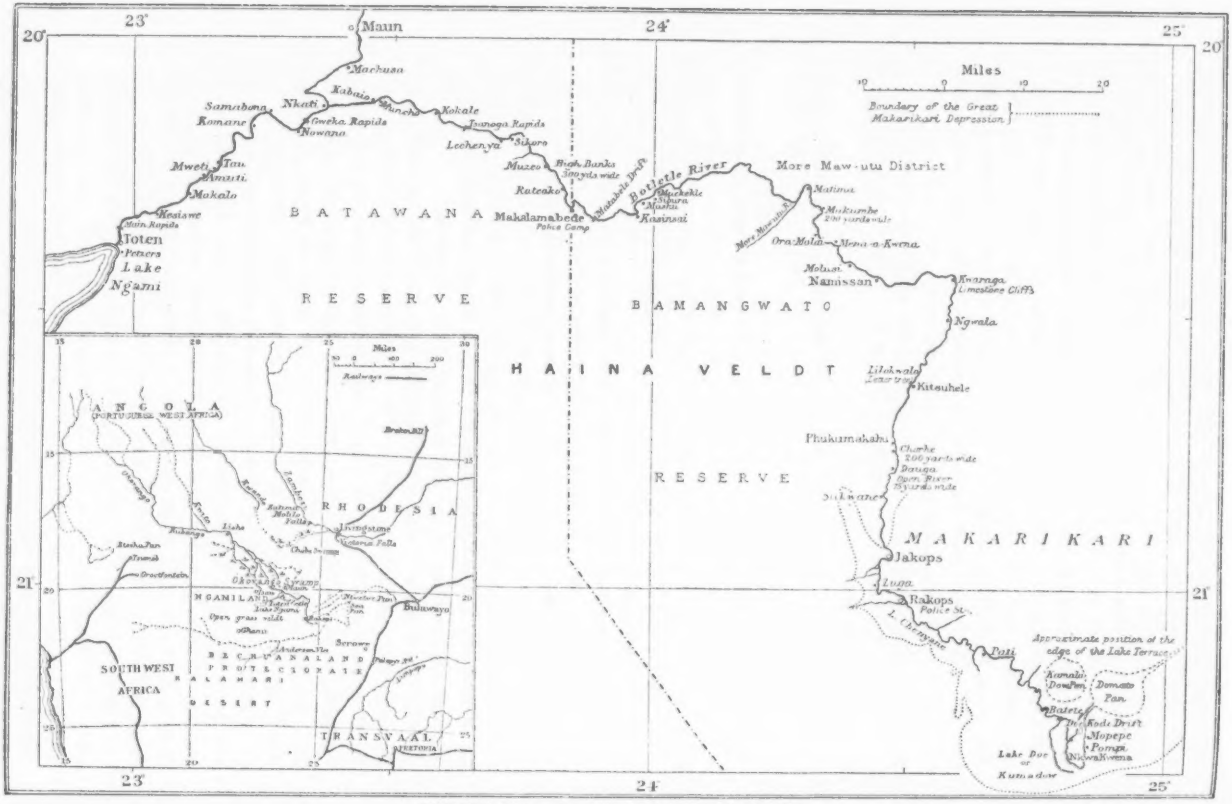
Nowadays, the Tamalakane enters the Botletle at right angles, and the waters divide; one part goes westwards to Ngami, and the other eastwards down the Botletle.

Usually the water in the Ngami river never gets beyond the Gwekwa rapids; it is here headed back. Before this year no water had flowed past the barrier since 1909, but the lower part of the Ngami river receives water from the Kunyare branch of the Okavango, so the lake has had water independently of it.

It is a very strange thing that the only outlet for the vast system of the Okavango swamps is down the narrow channel of the Botletle, and the Island of Maun—a fault-block of Kalahari limestone—stands athwart the entrance. The arrangement is sufficient as long as the water from the Okavango is dissipated in the swamps, but should a straight channel be formed across the delta, then the Botletle could not take the flood. The natural opening is from the Mababe to the Makarikari.

The Tsau river nearly broke through to lake Ngami this year. Formerly it must have done so, but Passarge gives the probable reason for the stoppage. The Makubas brought down tribute to Moremi at his town of Nukaning on reed rafts, and having off-loaded the corn, they set the rafts adrift. When the water subsided these grounded, and every joint in the reeds sprouted and struck root. Next year, when the water came down it found a dense mass of vegetation which it could not penetrate, so it had to spread out laterally. This obstruction was broken through, however, and the river advanced to just beyond Tsau, Sekgoma's town, and there spread out. This year it burst this second bank and advanced to Nauni, only a few miles from the lake.

The first mention of lake Ngami is by the Rev. John Campbell in 1813. He states that Motere, a headman of Mathibi's, left Lattakoo, and after a journey of five months reached a nation called Mampoor who reside on a great water, across which they could see no land. They saw people go on the water in bowls (coracles ?), and had pieces of timber



SKETCH-MAP OF THE BOTLETLE RIVER

which they put in the water and pushed themselves forward (poling in makoras). Oswell also gives the name "Noka a Mampoore," while the Rev. R. Moffat, in his map, 1842, states, "a lake hereabouts, extent unknown, called Mampoore, from the roaring of the waves."

The word Mampoore is close to the Masai *emburuo*, Bari *kapuro*, meaning "smoke," a very appropriate designation, as these reed marshes are always on fire. I saw the Chobe and Mababe marshes alight, and the Kumadow ones are described as "ever burning." Chapman actually saw a flash of lightning set an accumulation of reeds on fire in lake Ngami. The other name "Ngami" is the Masai *engare*, meaning "water," just as the Ovamboland lake, the Etosha, is the same as the Masai *aiposha*, meaning "a lake." The significance of the many resemblances of place-names to Masai words cannot be entered into here, except to state that the Hottentots were never round the lake, although they are the only people who speak a sex-denoting Hamitic tongue, mixed up with Bushman clicks, so the names are not due to them. It is difficult to understand the reference to the roaring of the waves; Chapman's natives told him they were sometimes so rough that hippopotami were flung on shore by them. It may be a reference to the roaring of the fires, with the joints of the reeds exploding, as Marco Polo explains they do from witnessing the effect in the swamps of the Tarim; but it more probably refers to a confusion in the minds of the natives with the other water that roars—the Mosi oa tunya, the Victoria Falls.

This year all the alluvial flats along the Ngami river were flooded, the central channel being marked by a double line of reeds. No papyrus extends south of the Gwekwa rapids, nor water-lilies, bulrushes, rushes, and such—only reeds; the luxuriant forest is replaced by thorn scrub. The makoras were poled over the shallow water covering the mealie fields, and we were continually forcing our way through thorn thickets. There was a great amount of wild cotton of two varieties, from which Oswell says that the Makalakas used to make cotton rugs, but they have now lost the art.

At the Haka rapids thorn trees grow right across the river. Below there is a stretch of pebbly gravel, made from fragments broken from the quartzite bar—a remarkable occurrence to find in a country which is mostly sand. Then come the main rapids, called Moma or Moumo. The water was swirling fiercely through the thorn trees, that had taken possession of the river-bed, as if the water was never expected to come down again. My canoe was upset here, and we had rather a struggle to get ashore. Beyond there is an apron of sand, over which the water ran in shallow runnels; then there was a deep stretch, and finally what looked like a complete block of high sand-mounds. The river had bored narrow channels through these, and our makoras spun through them like corks. Once past this obstruction, we came out on to a noble reach leading to the lake itself. Here the Kunyare joins the main

SKETCH-MAP OF THE BOTLETLE RIVER

stream, round the end of the island of Maun, and at the time was bringing down more water than the Ngami river. On the east bank is the plateau of Kalahari limestone on which is situated Lecholathebe's town of Toting, and on the west the low ground of the Okavango swamps.

The Ngami depression is a shallow fault-pit in the floor of the Greater Ngami, belonging to the series of the Baviaans' Kloof pits, and the Great Rift Valley system of Central Africa. The rim on the east is clearly marked by what is locally known as the Sand Ridge, some 40 feet high, on which grow camel thorns. On entering this old lake-floor the river divides into two branches, the one on the east passing over some extensive mealie fields, while the other is the "tauche" or deep stream. My boys could not touch bottom with a 12-foot paddle. The lake is now a vast meadow on which countless cattle belonging to the Damaras graze. These originally belonged to the Bakalahadis, and Campbell, when at Lattakoo in 1813, was told by Motere how he had gone up and murdered them, taking away their cattle. There has been a great confusion here between the Bakalahadis (a diminutive primitive race), the Tannekhoe or River Bushmen, and the Makubas, who are Bantu.

Coming back to the junction of the Tamalakane with the Botletle, the actual spot is a swamp choked with papyrus, bulrushes, and gomoti weed, a tall bush, growing in banks, somewhat like the rhododendron.

Immediately on entering the Botletle, one is conscious of the green chalcedonic rocks along the banks, so Passarge's term "Botletle Beds" for these basal quartzites is very appropriate. On the north bank is the district of Dauga, which name is sometimes applied to the whole river. The Dauga tree is the Hardekohl, or Leadwood (*Combretum primigenium*), that grows to perfection here; it is found along the Chobe, but it has been choked by the more vigorous forest, and the trees have died, leaving the whitened stems standing. The same tree is found in the very midst of the waterless Kalahari, stunted naturally, but a few good seasons would convert the northern Kalahari into an impenetrable forest. While speaking of trees, it may be noted that of all the baobabs that former travellers record as growing along the Botletle only one remains, and all the hyphænas have gone, except those in lake Kumadow.

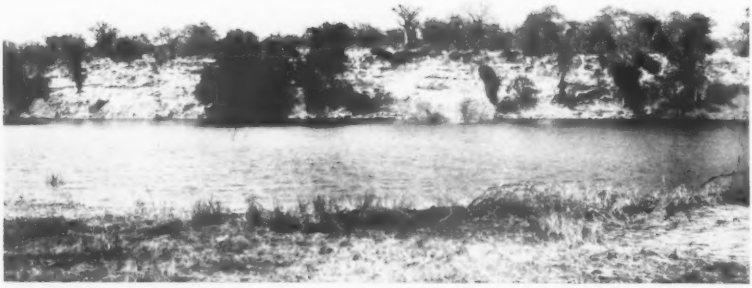
The waters of the Botletle are held up by a bar of quartzite at the Tsanoga rapids, corresponding to the Gwekwa rapids on the Ngami. Behind is a dense reed-swamp, with no free water at all, forming a very trying bit through which to have to force one's way. The river escapes from this in a dangerous rapid, in a channel neatly bordered with papyrus and bulrushes. The banks are covered with thorn scrub, with sansevieria growing between; Livingstone's "lilac" was in full bloom, probably moshesh or wild syringa. Towards Makalamabede, the dauga trees begin again.

The last-mentioned place is at the fork of the river; the name means "the Fork." A large tributary comes down from the Haina Plateau,

LAKE NGAMI NEAR THE POINT FIRST REACHED BY LIVINGSTONE

THE BOTLETLE AT TOTING

THE BOTLETLE LEAVING THE TSANOGA LAGOON



BAOBAB ON LIMESTONE CLIFFS, TAU, NGAMI RIVER

TSANOGA LAGOON

LAKE CHENYANE, A FLOODED MEALIE FIELD, NEAR NTWETWE PAN

and it is noticeable that this and the continuation of the main river form one line, while the upper Botletle joins the combination at right angles—an arrangement similar to that in which the Tamalakane joins the stream, and which gives weight to the theory that the whole river follows fault-lines of recent origin.

At More Maw-utu, there is a drift for the road going over to the Ntwetwe pan. The name is taken from a tree which grows here—the Octopus tree, or the tree with legs. Passarge suggests it is a *Cissus*. It has a soft stem, with a yellowish-green skin that peels off in papery scales.

It is not intended to go into the ethnology of the region here, but the following is a list of the tribes living along the Botletle:

Bechuanas: Batawana, Bamangwatos, Bahrutsis.
Damaras.
Makubas, Masubias, Mananswas
Bakalahadi.
Makalakas.
Bushmen: Tannekhoe (River Bushmen), Masarwas, Madenassenas, Batete, Qung, San, Bongo.

After the big bend at Kwaraga, the river enters a narrow tortuous channel, which might be called the Makalaka Gate, as it is the entrance to a region where that nation, after centuries of slavery, is once more growing into a compact whole.

At Kitsuhele, a large Bamangwato town, one is near the Lilokwalo, or Letter Tree. It is a Yellow wood, mutsiara (*Terminalia prunoides*). Only two sets of initials are left—"B. L." three times, and "C. van"; they are cut on the heart wood, where the bark has drawn away. Some one has lighted a fire at the base of the tree, and it is in a very bad way.

The long stretch southwards ends above Jacops in a lagoon. The river-banks disappear, and as far as one can see the ground is level with the water; this is the beginning of the Makarikari. The word means a mirage, or a shimmering, and is used to describe the salt-pans that occur in the depression, but the name has come to be applied to the whole of the old lake floor, extending to some 15,000 square miles. The Kalahari limestone plateau forms a tongue projecting into the western side, and down this runs the river. On the southern border there is a wide terrace raised 25 feet above the rest, formed of fresh-water limestone, usually changed into a green silicate rock, like the Botletle quartzite, but apparently of much more recent age. All limestones, from the Archæan dolomites to the most recent tufa, undergo this mysterious silicification, from the centre of the fragments outwards.

The smaller salt-pans are hollows in this terrace, and form an outer series; inside them is the Botletle, with the two expansions, that forming the gathering-ground for the Ntwetwe pan, which I propose to call lake Chenyane, and the Kumadow, which supplies the Domato and Soa pans.

The section between Jacops and Racops, two large Makalaka towns, is apparently the blocked-up outlet of the whole of the Makarikari. There are small channels from the main river, corresponding to Passarge's stream-beds, leading to the Letyaho, the Okwa, and Andersson's Vley, or Gofhamodino, as it is now called. At Sesume's town there is a great slab of limestone, a couple of feet above water-level, on which the houses are built; it looks for all the world as if it were artificial, and had been made for the special convenience of people who go down to the river in boats. This is the Zouga, "That flat thing!" from which the river has been named by some travellers; but the term should only be applied to this particular stretch. Ordinarily the flood-water stops at Racops, and four months before I was there, the river was a succession of foul stagnant pools, full of crocodiles; Chapman counted fifty-six in one pool.

At the old fig tree, the only muchaba (*Ficus gnaphanocarpa*) along the river, there is an important outlet to the north-east, corresponding with Chapman's feeder to the Ntwetwe pan; the banks are lined on both sides with tall trees, so it is not just a break-through of the flood waters. The river becomes a wide marsh, with black lake soil, similar to that in the Mababe and lake Ngami. There is a considerable stream flowing through it, so the level of this expansion is higher than that of lake Kumadow, from which, also, it is separated by a definite bar of limestone. I would call this sheet of water lake Chenyane, from the Makalaka village of that name.

From now onwards the river flows through true marshland, with numbers of clumps of hyphæna palms, mostly dead. At Sosoane there used to be a thousand, but only two hundred remain; but what are left give the country an extraordinary look of Egypt. The Makalakas cut down the palms to make drinking-troughs for their cattle, and as the palms are the only trees in the marsh, one cannot blame them. The long-horned cattle are the Egyptian breed brought down by the Damaras.

Lake Kumadow is Chapo's Marsh. He was a chief of the Bahrutsis, who came here to escape the depredations of the Matabele, somewhere about the beginning of last century. Here, amid the trackless bogs and ever-burning fires, he was safe, and all the various tribes round about put themselves under his protection. It is remarkable that with such a following, and with such a fertile district, the Bahrutsis never formed a nation of their own; they acknowledged the sovereignty of the Bamangwatos, to whom they paid a yearly tribute of karosses. The Masubias and Makubas are just the same; they are fine, industrious people, but no leader has arisen to weld them together.

Up till this year no water had been down to Mopepe since 1905, when a trader, Chadwick, came down in makoras from the Mababe with a freight of otter-skins; but before that there was enough water to float boats carrying 6000 lbs. These barges are still in Ngamiland, and are used locally during flood-time; but they will never come down to

Mopepe again. I had the greatest difficulty in forcing my way through in my small dug-out canoes in this which was considered a record flood. There must have been a considerable flow not so very long ago, for the stream-bed below Mopepe is lined with the stumps of gigantic muchweri trees.

The arrangement of the water at Mopepe is a very perplexing one, and could not be even guessed at unless the channels were full. In recent years the area has been surveyed by Passarge in 1897; in 1909 Dr. Graetz came in a motor car from South-West Africa. In 1910 a party of twelve Germans came along with speedometer and a cartographer; Dr. Seiner was through in 1911; and in 1914 Messrs. Ziegler and Theron came here photographing. In 1924 the locust expedition passed through, under Col. Williams.

At Gomo, E. C. Ingleton's store, there is the Kode inlet into lake Kumadow. It runs more or less parallel to the Botletle, joining a similar inlet at the Doe Kode drift. The united stream flows south and disperses through the marsh in a number of small runnels. The main stream turns south at Karapa drift, where I had to abandon my boats, and turns round at Pororga drift, comes north and would flow into Domato pan, but this year the water came only as far as the Chukwe pan. Another branch comes off at Pororga drift, which makes a similar loop further south, and the channel comes north and joins the other one some 6 miles north of Mopepe. This loop was quite dry, but it carries an abundant and permanent supply of underground water, so the large towns of the Bahrutsis, Chapo, Pompi, and Racomo, are built along it, and the Makalaka town of Mopepe as well.

At Nkwa Kwena there is a bar of green quartzite holding up lake Kumadow, and only when the water rises above this sill can any flow towards the Soa. This latter pan is filled annually, but from the east; never more, nowadays, from the west.

The soil of the Kumadow is precisely similar to that in the Mababe and Ngami; it ignites spontaneously, forming burning pits, which are very dangerous, as when a native falls into one nobody will venture to help him out. Wind devils race over the surface, raising enormous columns of black dust, resembling smoke, and the upper air is charged with the fine vegetable particles. I have obtained similar material from the roofs in Kimberley after what has been called "black rain," and no doubt the origin of the dust was in one of these Ngamiland lakes.

This year the floods have not been reinforced by additional rain, and lake Ngami is drying up and smelling horribly. In lake Kumadow the same is probably happening. Immense numbers of fish, mostly bream, come down the river, and are caught in hundreds by the Batete Bushmen; when the lake dries they lie about on the surface and rot, but the natives collect them and eat them all the same. The odour of putrid fish comes through their skins, making them unpleasant companions.

THE RADIO-TELEGRAPHY OF THE HAMILTON RICE EXPEDITION, 1924–25

EARLY in 1925 we received two wireless messages from Dr. Hamilton Rice on the Rio Branco, the first through Mr. Gerald Marcuse's station at Caterham, the second by the courtesy of Mr. E. J. Eckert, of Philadelphia. The remarkable success of the short-wave transmission, used for the first time by an expedition in the field, makes it desirable to publish the technical details as soon as possible, for the instruction of other geographers. Dr. Hamilton Rice has very kindly placed at our disposal the reports of Mr. John W. Swanson and Mr. T. S. McCaleb, his two wireless operators, and also the report which Capt. A. W. Stevens, of the U.S. Air Service, made by his direction to Major-General Mason M. Patrick, Chief of the Service.

The three reports naturally overlap, but it seems better to print them nearly in full than to risk elimination by an inexpert editor. The importance and novelty of the material justify a treatment more technical than is usual in the *Journal*.

REPORT BY JOHN W. SWANSON

On two previous expeditions with Dr. Hamilton Rice, from October 1916 to June 1920, the use of radio equipment was confined solely to receiving time signals, and press despatches from the United States and Europe which kept the members of those expeditions fully informed of current events. A report on this work appears in the *Geographical Journal*, October 1918 and September 1922.

With the rapid development of the radio art since the 1919–20 expedition it was in logical sequence that Dr. Rice should incorporate as one of the objects of the 1924–25 expedition into the Brazilian Amazonas and Venezuelan Guayana the test of radio communication in the field.

Dr. Rice decided to embark on this project prepared for any emergency, and about $6000.00 worth of selected radio equipment was purchased. Not only were sufficient spare parts taken on this expedition but a large quantity of radio material for experimental work, anticipating the fact that we could improve our equipment from time to time or build new apparatus if circumstances warranted.

Offices were rented at 80, Beaver Street, New York City, from 1 January 1924, and here all our materials and apparatus were assembled or constructed. Mr. Thomas S. McCaleb, former radio laboratorian at the U.S. Navy Yard, Norfolk, Virginia, was the writer's capable assistant.

Provision was made for the following equipment:

1. A supersensitive radio time signal receiver, having a wave-length range of 1000–20,000 metres; loop antenna, 1 stage of radio frequency amplification, detector, and one stage of audio frequency amplification. The radio frequency transformer consisted of honeycomb coils which were interchangeable for the various wave-lengths. A circuit diagram is attached hereto. The receiver was enclosed in a moisture-proof case constructed of brass, and could be submerged in water for hours without damage (see Fig. 1).

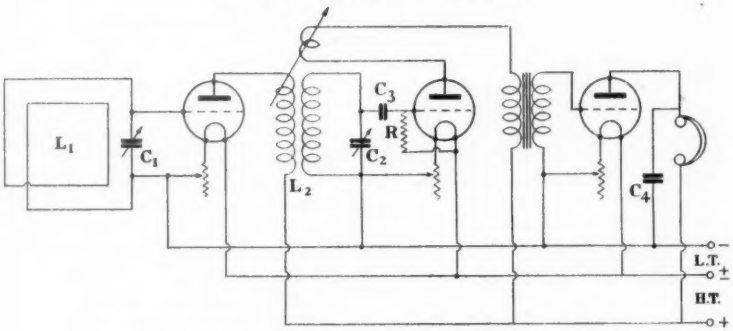
2. A portable base radio station consisting of a ½-K.W. vacuum tube transmitter to operate on the wave-lengths of 95, 1500, 1950, and 2250 metres. This

transmitter consisted of 8 UV 203 A R.C.A., V.T. tubes paralleled in a standard Hartley circuit. A circuit diagram is included herewith [not reproduced].

The primary power plant for this transmitter was a 1½ K.W. Delco electric 110-volt system. A generator driven by an efficient kerosene motor arranged in a very compact unit charges 60 cells Exide storage battery, 100 ampere type. A standard dynamotor of the Electric Specialty Company 110 volts D.C. primary, 1200 volts D.C. secondary at 1 ampere, was used for supplying current to the plates of this transmitter. The windings of this machine were especially treated to withstand moisture. A 12-volt 210-ampere-hour battery supplied current to the filaments of the tubes.

3. A portable 25-watt V.T. transmitter to operate on a maximum wave-length of 100 metres, for use by the advance party in communicating with the base. This transmitter utilized two 50-watt UV 203 A R.C.A. vacuum tubes, arranged in a standard Hartley circuit. Two 6-volt 40-ampere-hour Exide

FIG. 1.—TIME SIGNAL RECEIVER



Wave-length range, 1000 *to* 20,000 *metres.*

L_1, Loop Antenna.
L_2, Honeycomb Coils, covering range of wave-length.
C_1, Variable Condenser, 1000 $\mu\mu$F.*
C_2, Variable Condenser, 1000 $\mu\mu$F.
C_3, Grid Condenser, 250 $\mu\mu$F.
C_4, By-pass Condenser, 2000 $\mu\mu$F.
R, Grid Leak, 2 MΩ.
L.T., Low Tension Battery.
H.T., High Tension Battery.

storage batteries supplied current to the Electric Specialty dynamotor, 10 volts D.C. primary, 500 volts ·3 amperes secondary. The complete equipment, exclusive of the battery-charging unit, which consisted of an automobile generator bolted to a small gasoline engine, weighed but 50 lbs. (see Fig. 2).

4. A 10-watt V.T. transmitter and radio receiver for the air-plane. This equipment including necessary accessories weighed 50 lbs.

"B" batteries manufactured by the Burgess Battery Company, Madison, Wisconsin, were selected. The smallest size made were connected into 45-volt units and placed into small light wooden boxes made large enough to receive them and still allow the battery to be completely covered on all sides with pure paraffin. Packed thus, a battery will withstand considerable mishandling and

* To convert the condenser ratings from micro-micro-farads ($\mu\mu$F) to micro-farads, divide by one million. *E.g.* 1000 $\mu\mu$F = ·001 μF.

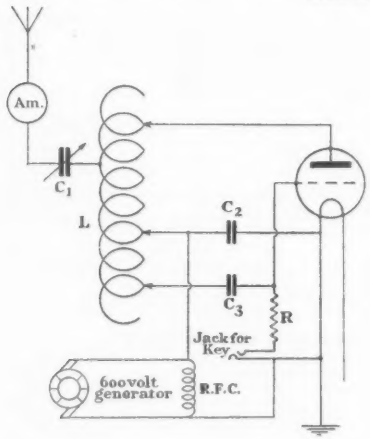
have absolute protection against moisture, which is the chief cause of rapid deterioration of dry-cell life in the tropics.

The electrical measuring instruments as manufactured by the Weston Electrical Instrument Company were used exclusively, and consisted of various milliammeters, ammeters, voltmeters, thermo-galvanometers, thermo-ammeters, resistances, etc.

Two wave meters were included in the equipment: one covering the short-wave band 40–150 metres, and one covering the band between 150–3000 metres.

All equipment was in order and ready for packing by 15 March 1924. Special attention was given to packing. Each individual piece was carefully protected and wrapped, and then packed away in extra strong boxes which had been lined with a heavy tar paper that affords a certain amount of protection against moisture and the attacks of insects. The cases were purposely made small so they could be easily handled—a very important factor in the successful shipping of heavy but delicate materials.

FIG. 2.—FIELD STATION PORTABLE TRANSMITTER. STANDARD HARTLEY CIRCUIT



Wave-length range, 40 to 100 metres.

The diagram has been rearranged to make it more easily comparable with No. 3.

L, R.C.A. Oscillation Transformer.
C_1, Variable Condenser, 500 $\mu\mu$F.
C_2, Fixed Condenser, 2000 $\mu\mu$F.
C_3, Fixed Condenser, 2000 $\mu\mu$F.
R.F.C., Radio-Frequency Choke.
R., Grid Leak, 5000 ohms.
Am., Ammeter.
Input, 50 Watts on 100 metres.

At this time the Brazilian Radio Laws strictly prohibited all but Government-operated radio stations; but, through the efforts of the American Ambassador to Brazil, a licence to operate our equipment was granted by the Brazilian Government, and permission was given to use the American call signal "WJS" allotted by the U.S. Department of Commerce subject to the approval of the Brazilian Government. In the course of negotiations I had occasion to visit the Ministro do Viacao, or Commissioner of Public Works, who is charged with the supervision of all radio matters in Brazil. The courteous manner in which this piece of important business was handled will always be a pleasant recollection. When the proposed radio work of the expedition was thoroughly understood, not only was permission granted to work with the radio station at Manaos, but telegraphic instructions were sent to the Federal Radio Inspector of the Amazon District to extend us all possible cooperation. Dr. Manoel De Barros, Chefe do Distrito Radio Amazonas, was untiring in his efforts to assist us in making the radio experiment a success. Permission was granted

to erect our experimental station at the Manaos Radio Station (SQM) grounds. Dr. Barros was responsible in no small degree for the success of our work.

The collapsible hut for the base radio station WJS was built at Manaos and subsequently erected on the grounds of the Manaos radio station. It is a simple structure, a few posts accommodating screened panels, designed for practicability and the comfort of the operators. Under the canvas of our hut, safe from the onslaughts of mosquitoes and other pestiferous insects, we successfully communicated with Para, about 850 miles from Manaos as the crow flies, using our tube transmitter with a power of 400 watts input to the antenna on a wave-length of 1500 metres (200 kc.). With that accomplishment went some assurance of success. Tests of short-wave receiving equipment at Manaos did little to bolster the confidence of the radio detachment. Nights of dial twisting and ear straining brought in but three short-wave stations, two of them broadcasters. Hearing KDKA and WGY with regularity on high frequency was, it is true, a distinct contribution to the expedition's entertainment, but reception of a lone code station—it was 8XI—was discouraging.

The next test involved the radio equipment for the air-plane. Successful communication was established with the air-plane from the experimental base radio station. However, the plane used was not sufficiently large to accommodate the weight of a radio operator in addition to the pilot, aerial photographer, etc. This enforced the abandonment of that important radio communication link.

Radio work at Manaos was drawing to a close when a political tidal wave engulfed the town. On July 23 we found ourselves in the midst of a revolution. The upheaval hampered the expedition's work but little, though it brought an end to radio tests. Under rebel rule, with absolutely no communication with the outside world, the mails, cable, and radio services being interrupted, Dr. Rice was the only other man in Manaos conversant with current events, for with our loop long-wave receiver I heard the news from the world over.

When the time came to move up-river, an old stern-wheel steamer transported the party to Vista Alegre, on the Rio Branco. Arrangements had been made with Dr. Barros that, should the revolution cease and it was possible for him to do so, the Manaos station was to broadcast the expedition's messages. On 7 September 1924 the Manaos station broadcasted that the revolution was over, and a series of important messages for the expedition was received.

Ascertaining that Vista Alegre was a poor radio location, we placed our equipment aboard a batalao, towed by a steam launch, and proceeded farther upstream to Boa Vista, which was to be the expedition's base.

McCaleb went down with high fever the day of his arrival at Boa Vista. Two weeks he lay ill at the small mission, attended by the kindly padres. While he convalesced, the erection of a station at Boa Vista went forward, the main trouble encountered in putting it up being inability to secure timber for masts in a treeless territory. Four days' journey from the camp mast material was found, cut, and floated. With the help of natives, most of them Indians, three masts, 80, 75, and 40 feet high, went up. An antenna for long-wave work was suspended between the two highest: a short-wave antenna was hoisted between the shorter sticks. There was an elaborate ground system for long-wave work, and a litzendraht cable counterpoise for the high-frequency set. Our radio hut in place, a barbed wire fence was erected enclosing the station, to protect us from half-wild cattle that roamed the campos.

There followed six days of calling and listening while static alone caused the headphone diaphragms to vibrate. Two operators were deep in the dumps,

half sick, and nearly played out, when a woman's voice floated in on the 60-metre wave. The song, ironically enough, was " Happy Days." KDKA's short-wave set did a physician's work at Boa Vista that night.

The next night an American amateur shattered the silence with a readable signal, but failed to respond when called repeatedly. This was a disheartening chapter, and the events of the next few days produced more gloom. McCaleb, sent down the river to join the expedition proper at Vista Alegre, took with him the 25-watt transmitter, hoping to effect communication with the base station WJS at Boa Vista. The attempt failed dismally. The only silver lining during these days of discouragement was that another American amateur was heard, and WSC, an American coastal station of the Radio Corporation of America, boomed in. They could not be made to hear us, however. Then things brightened, for Manaos, called in vain for days, one morning responded with a snappy " OK " reporting signals strong and clear.

The base party having established itself at Boa Vista, and McCaleb in charge of WJS, the advance party early in December started on its journey, the 25-watt transmitter, under the care of the writer, accompanying it. Communication between the two parties was established without difficulty after the advance party had made some progress, and radio stock soared. Equipment overlooked when the party set out, and needed urgently by the scientists, was ordered and despatched in pursuit from Boa Vista. The portable set was demonstrating its usefulness.

At this juncture, with things going swimmingly, partial failure loomed in the radio detachment's path. The rock on which the plans threatened to wreck was the heavy tube mortality at WJS. The 50-watters expired in such numbers that not enough remained to power the long-wave base transmitter. The Boa Vista–Manaos link broke, and the expedition's communication with the outside world was disrupted.

Short waves and the American amateur saved the day. During the months since the expedition's sailing, the great amateur migration to the 40–80-metre band had taken place. So, unable to work Manaos, which was, as radio distance is measured, but a step away, WJS began shooting Rice Expedition traffic almost daily to American amateurs. First two-way communication was effected with 2CVS, Ellison Thompson, New York City. This success was followed by the transmission of long and important messages to dozens of other amateurs in the United States. Stations 2 AG, C. R. Runyon, Yonkers, N.Y., and 2 BR, operated jointly by A. C. Lopes and J. W. Baldwin, handled the bulk of our messages in a praiseworthy manner. Messages were also exchanged with G2NM and G2OD in England ; CB8 in the Argentine ; and the United Fruit Company's efficient station at San Jose, Costa Rica.

Some of the traffic was destined to American points, but much of it was addressed to Manaos. Consider what this meant : Manaos was about 400 miles from WJS, but could not be reached direct during the tube shortage days. A message for Manaos went 3000 miles by ether to the United States, 3000 miles by cable from the United States to Para, Brazil, then another 1000 miles by cable to Manaos. Costly ? No end ! Subject to delays ? Yes, frequently. But the messages, many of them of utmost importance to the party, reached those to whom they were addressed, and that was the object of the game.

In a clumsy, heavy, spoon-billed craft, more scow than canoe, radio made its start up the angry river, its guardians being Weld Arnold, topographer ; Indian boatman of the region, Antonio, in whose veins ran mixed negro and Indian blood ; and the writer.

THE BOA VISTA STATION

MR. SWANSON RECEIVING AT BOA VISTA

SHORT-WAVE TRANSMITTING (Fig. 3) AND RECEIVING SET (Fig. 4)

LISTENING IN ON THE RIO BRANCO

SHORT-WAVE RECEIVER (Fig. 4) SET UP FOR STATIC STRENGTH

MR. McCALEB RECEIVING A SHORT WAVE IN THE FIELD: TIME SIGNAL RECEIVER AND FRAME AERIAL IN BACKGROUND

Erection of an antenna was the first step in the establishment of radio stations at the jungle camps. Trees were the masts, and the vegetation for some distance about the antenna trees was cleared away to give the wires breathing space. The receiving antenna was usually a 30-foot length of wire, suspended 1 foot off the ground. The low antenna reduced signal strength materially, but reduction in static more than compensated for this loss. In a tropical region, where every night is a static night, LR, the field station, thumbed its nose to atmospherics. Obtaining an efficient ground was no problem ; a length of antenna wire thrown into the river served well.

Having nothing but the long-wave time signal receiver with which to receive WJS signals, the operator had an interesting time away up there in the forest with this sudden and unexpected introduction to communication on these very short wave-lengths. A short-wave receiver, put together in the wilds out of odds and ends, including two empty sugar-tins procured from Kwong, the Chinese cook, was an instrument that would bring a blush of shame to the cheek of the radio constructor who likes to see things shipshape. That its appearance was not a measure of its sensitiveness was demonstrated when it picked up amateur signals from every radio district of the United States, and from many foreign countries. A simple Armstrong circuit was used.

The transmitter, designed for maximum efficiency on 100 metres wave-length, was reconstructed up-river after its operator became convinced that better results were obtainable lower down the scale. Alterations fitted this set for 80 and 40-metre work.

The lack of a wave meter at the portable station was met one night when the operator had the good fortune to pick up the standard frequency signals emitted by WWV, the Bureau of Standard's station at Washington. Utilizing the system of harmonics, a hastily assembled but accurate instrument was calibrated.

The portable station's power supply was a dynamotor operated by storage batteries, which were charged by an automobile generator bolted to an out-board motor, which in turn did canoe duty at other times. Both outboard motor and generator threatened frequently to give up the ghost, but were nursed along to a remarkable performance by the gas-engine experts of the party. who lent a hand to the radio operator when failure of the power supply loomed.

Anti-ant measures became a regular part of radio routine after the short-wave receiver, opened one day for inspection, was found to be full of very live radio bugs. Hornets, of a species which build a mud dwelling, took possession of LR one day up-river. The operator found that all crevices in the apparatus had become hornet home-sites. Their mud huts shorted the grid and plate terminals of one transmitter tube, and a veritable firework display resulted when the current was turned on.

There were few nights spent in camp when traffic was not exchanged between WJS and LR, and scarcely a night when signals from American amateur stations were not heard on the crude short-wave receiver. Owing to the necessity of conserving power, the portable station's messages destined to the outside world were habitually sent to the base station, which relayed them northward. This was, however, no insult to the 25-watt set at LR, for on one occasion, when the operator's curiosity to learn how the low-power equipment would reach out got the best of him, he passed with ease a message direct to station 4DO of M.M. Burns, at Atlanta, Ga. We were quite surprised to learn that the signals from this small transmitter were being received all over the United States.

There were times when, unsuccessful in raising WJS on 80 metres, a shift to the 40-metre wave brought immediate results. Even after nights when signals carried poorly, when static was terrific, there was a short period just following sunrise when the world could be heard. Sometimes this fruitful interval lasted two hours, often not longer than fifteen minutes.

The amount of power used in transmission appeared not to be a factor of much importance. Many of the amateurs heard in the forest were using sets with as little as 10 watts of power. McCaleb reported that he was often warned that LR was about to call by a clearly audible sound which could only have been occasioned by a minute amount of radio frequency energy leaking into the antenna when the tubes were lighted but when the key contact points were not actually meeting.

Elevation above sea-level was important, the ease with which traffic could be handled apparently varying consistently with the elevation. During early evening the short waves gave poor results. It was a rare night when much work could be done before nine o'clock.

On a whole, while transmission on high frequencies proved to a certain extent freaky, communication was established over such long distances, with so little power that the conclusion seems unescapable that short waves will come to be used extensively in long-range work. We have not yet solved many of the mysteries of their propagation, but we have opened the gate wide enough to enable us to see that there is much inside the field we hardly realized, until recently, was ours to explore and to use. Hereafter there is no reason why any properly equipped expedition, with a mere handful of apparatus, cannot be in daily and reliable communication with the outside world. Dr. Rice has demonstrated to the world that this work can be done, and he deserves the highest commendation for opening this new field for radio communication.

REPORT BY THOMAS S. McCALEB

The expedition carried wireless equipment to receive time signals from Balboa, Panama, and Annapolis, Maryland, for daily chronometer checks, and for reliable communication with its base and the United States.

The original scheme for establishing communication from advance party to base made use of short wave-lengths in the neighbourhood of 200 metres. From the base, where all traffic was relayed, a wave-length of approximately 3000 metres was employed to communicate with the Brazilian station at Manaos, 400 air miles south of the base at Boa Vista. At Manaos traffic was further relayed *viâ* cable to New York, and thence to its destination *viâ* Western Union Telegraph.

This crude method proved unreliable and required considerable time; moreover, there existed numerous dangerous opportunities for errors in the various relays. After this system of communication had been in effect for three months, extreme adverse atmospheric conditions practically limited the transmission and reception of messages to approximately 150 words per week. Later, with the use of short waves, it was possible to handle on an average 150 words daily.

The Rice Expedition was the first to attempt radio communication in the tropics on a short-wave system. The entire operation was no more than an experiment, for everything pointed to defeat. The miles of tropical forests to absorb energy of transmission, atmospheric conditions that seriously interfere with reception, and a peculiar kind of atmosphere that absorbs electro-static and

electro-magnetic energy make communication unreliable between Brazilian stations using 40 k.w. of power to cover a distance of 800 miles. Probably the greatest obstacle was moisture, which may cause serious damage in the high-potential circuits of a transmitter and render receiving equipment inoperative.

In designing and constructing the radio equipment used on the expedition all these obstacles were taken into consideration and the conditions likely to be met with were taken care of in the best manner possible, principally by making the apparatus capable of withstanding overloads and preventing the entrance of moisture by constructing parts of moisture-proof material.

The Time Signal Receiver.—The original time signal receiver was made in three parts: the collector or loop, the receiver, and the power system which consisted of a 6-volt, 40-ampere-hour storage battery, and anode batteries. The receiver contained a standard three-valve circuit, one stage of high frequency amplification, detector, and one stage of audio-frequency amplification. This unit was encased in a brass box, and its cover hinged down on a rubber gasket surrounding the outer edges.

No further description need be given, as this receiver was entirely too cumbersome, considering that a time signal receiver could be constructed within a weight of 30 lbs., and the entire apparatus encased in a box whose dimensions should not exceed 12 inches long by 6 inches high, and 6 inches in depth. It is recommended that dry batteries supply power and the super-heterodyne principle for reception be employed.

Time signals were received twice daily from Balboa and Annapolis under the worst conditions. Regardless of atmospheric or geographic conditions a perfect time check was always obtained. For example, while returning downstream in a canoe going approximately 6 miles per hour with the current, shooting minor rapids and following the many twists and turns in the narrow river (Furo de Maraca), the operator stood up in the canoe and rotated the loop in order to keep the loop's plane always pointing towards the transmitting station for maximum signal strength. After receiving for three minutes a strong wind blew the loop, which was sewn in cloth, from its frame. This necessitated the operator temporarily converting himself into a loop frame by supporting the loop with outstretched arms. Only one half-minute was lost in the change, and no perceptible difference in signal was noted. Besides successful time signal reception, a newspaper was published.

During the final lap of the journey up the Uraricoera it was necessary to reduce weight, and an experiment was tried with dry batteries formerly used for gasoline engine ignition, and flashlight batteries, as power supply for the filaments in the receiver. This proved to be most satisfactory and considerably reduced weight. Also dry batteries are far more practical where natives are used as carriers, for there is no acid to be spilled. It seemed to be a practice among Indians and Brazilian natives to place a storage battery in an inverted position.

Flashlight batteries were used successfully to furnish power for illumination lamps on the theodolite. These batteries may be covered with paraffin and kept for more than a year until put into actual service.

NBA (Balboa) was to be the time-signal station for our chronometer checks, but by careful comparison between NBA and NSS (Annapolis), Balboa was found to have an error which increased gradually up to as much as three-tenths of a second, reaching a maximum at the end of two weeks. Thereafter (exact date unknown) the signals would check and the error at NBA would again occur.

At two points on our journey hills 1000 feet in height completely encompassed the camp located in thick jungle ; yet, with this combination of screens, excellent reception was obtained from both Balboa and Annapolis on long waves 7500 and 17,500 metres approximately. At these two points just described, successful short-wave communication was established between New York and Canada during severe electrical storms.

Short-Wave Equipment.—On 14 December 1924 a small transmitter and receiver designed to work with frequencies from 3000 to 7000 k.c. (100 to 40 m.) were designed, constructed, and put in operation. Station 2CVS in New York City was the first to communicate with the expedition. One week later stations 2MC, 2AG, and 2BR established nightly schedules, and most of our traffic was handled through them. Numerous others all over the United States also handled messages. Besides communication with regular scheduled stations, others in various parts of the world were "tied in" as possible links in our system. The greatest distance covered was 8500 miles, with Station 2AP at Wellington, New Zealand. At the base station the approximate power delivered to the antenna was 150 watts at 3750 k.c.

Station 2NM, at Caterham, Surrey, owned by Mr. Gerald Marcuse, was the first English station to communicate with the expedition. Several messages from Dr. Hamilton Rice and the Royal Geographical Society were handled and a precedent established for communication from expedition in the field to the R.G.S. Had not the operator at the base station been handicapped by fever a regular morning schedule could have been maintained with 2NM.

To the Radio Club of America, and members of the American Radio Relay League, great credit is due for efficient, rapid, and accurate transmission and reception of messages of the expedition.

A record was established by Station 2AG at Yonkers, New York, when a message of twenty-five words to New York City was delivered and a reply received by the sender at the portable station on the Uraricoera. The total time was 7·5 minutes. It was necessary to telephone the message from Yonkers to New York City.

An urgent message was also sent to the S.S. *Leviathan*. This time 2AG received and delivered the message to the Radio Corporation of America, who relayed it through their large land station.

Short-Wave Transmitter.—The transmitter design followed new principles. All parts in any magnetic field were made of wood impregnated with paraffine, which offers the lowest possible loss of power. No panel was used, but all apparatus mounted on a small wooden board. All connections were made short as possible and ran direct to the instrument next in circuit. The appended schematic diagram is self-explanatory (Fig. 3). The circuit L1, C1, determines the frequency of the transmitted wave, and by virtue of their ratio a high capacity and low inductance form an ideal low-resistance circuit.

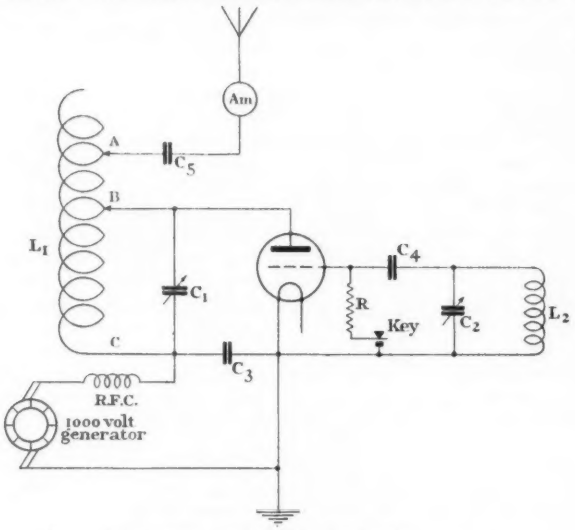
The antenna is coupled by a very low capacity of 0·000025 micro-farad. This reduces considerably the effect of swinging, or varying antenna constants on the outgoing frequency. With this arrangement of tuning grid and anode circuits, the transmitter becomes a potent oscillator, and no difficulties will be encountered when using harmonic radiation. As proof of this, the eighth harmonic of the long-wave antenna at the base station was used with great success. By connecting the anode tap across L1, C1 at point "B," the tube capacities are added to C1 and C2, which prevents circuit from "swinging over" to other electrical periods in circuit—an ideal arrangement for ultra-short waves. Primary source of power was 1½ K.W. Delco, 110-volt system.

Receiver.—Like the transmitter, the receiver follows new design, mostly original, using only such parts as would be essential to efficient operation.

The inductances were made of number 18 D.C.C. waxed wire. This was the proper size for minimum high-frequency resistance ; any larger wire would only involve losses due to eddy currents. The inductance coils were self-supported and made rigid by sealing wood strips at four points around their periphery.

The three sockets were mounted on a strip of " bakelite " ; underneath were filament resistance and audio-frequency amplifying transformer. The central valve functioned as a high-frequency magnifier, and its four terminals of copper bus bar one-sixteenth inch thick, connecting to the two variable

FIG. 3.—SHORT-WAVE TRANSMITTER. ARMSTRONG TUNED PLATE CIRCUIT



The diagram is from Mr. Swanson's report.

L_1, Plate Inductance of 9 turns, $3\frac{3}{4}$ inch diam. (4 turns between B and C).
L_2, Grid Inductance of 5 turns, $3\frac{3}{4}$ inch diam.
C_1, Variable Condenser, 1000 $\mu\mu$F.
C_2, Variable Condenser, 500 $\mu\mu$F.
C_3, By-pass Condenser, 2000 $\mu\mu$F.
C_4, Grid Condenser, 25 $\mu\mu$F.
C_5, Antenna Condenser, 25 $\mu\mu$F.
R.F.C., Radio Frequency Choke.
Am., Ammeter.

condensers, formed supports for the entire valve unit. This compact arrangement made possible extremely short connectors. By simply changing inductances this receiver would function efficiently over a range of 40 to 17,500 metres.

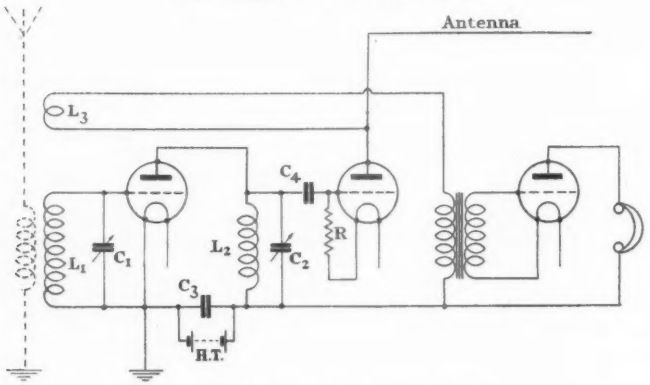
This circuit is very similar to the transmitter circuit involving the tuned plate and grid in the H.F. amplifier. The voltage to operate the detector is gotten across the coil, in circuit L2, C2. This is highly desirable, for by virtue of a parallel resonant circuit of low resistance, maximum voltage drop occurs across the coil when this circuit is resonant to the incoming

signal frequency; any other signal off resonance will produce a lesser voltage drop with a consequent reduction of interfering signal.

A unique method of coupling the antenna is shown in the diagram. The inductance L_3 used as a reaction coil also inductively couples the received signal energy to input of H.F. amplifier. The antenna is connected directly to anode of detector. This arrangement reduced atmospherics to a larger degree with the accompanying result of an increased signal. No definite theory can be given at present as to the exact effects produced in this circuit by coupling antenna energy through the reaction coil.

An excellent instrument for use in the field would be a single unit combining short-wave transmitter and receiver, the receiver capable of functioning over

FIG. 4.—SHORT-WAVE RECEIVER



The diagram is from Mr. Swanson's report.

L_1, Inductance Coil, 7 turns.
L_2, Inductance Coils, 6 turns.
L_3, Inductance Coil, 7 turns.
C_1, Variable Condenser, 500 $\mu\mu$F.
C_2, Variable Condenser, 500 $\mu\mu$F.
C_3, By-pass Condenser, 2000 $\mu\mu$F.
C_4, Grid Condenser, 250 $\mu\mu$F.
R, Grid Leak, 2 MΩ.
H.T., High Tension Battery.

By changing the inductance coils, this receiver worked efficiently over a wave-length range of 40 to 17,500 metres.

The antenna was originally coupled as shown by the dotted line, but this arrangement was abandoned in favour of an antenna 30 feet long placed 6 feet above the ground.

The filament battery circuit is omitted for the sake of clearness.

a range of 40 to 17,500 metres. This unit may be encased in a metal box of duraluminum and made moisture proof. The lid or the top should contain transmitter inductance so that this inductance may have its field free of metal. The overall weight (primary source of power excluded) might be within 50 lbs.

The secondary source of power would be derived from a 12-volt 80-ampere-hours storage battery placed in a box with the anode battery. The primary source of power would be a two-cylinder gasoline engine of small dimensions: on one end of the crankshaft a high-tension generator directly connected, and on the other end a low-tension generator for filament power. With this arrange-

ment for primary power, the low-tension generator may be used as a self-starter for the gas engine. Dry cells will supply the modern low-current receiving tube.

Portable Radio Station.—After the base radio station was closed down in March 1925, the receiver used at that station was sent to the portable station, and the original transmitter reconstructed to design of base transmitter.

The original primary source of power was a 2-H.P. single-cylinder gasoline engine weighing approximately 75 lbs. This unit contained a 12-volt generator belted to the flywheel, but owing to mechanical faults it was abandoned, and the generator removed and belted to an outboard canoe motor, which served efficiently throughout a period of three months. This generator was used to charge a 12-volt 80-ampere storage battery. This low potential power was converted by a dynamotor. The transmitter was connected to a one-wire antenna 40 feet long that was supported by trees. Here an extraordinarily small amount of energy, in the neighbourhood of 25 watts, found its way through the thick foliage of the jungle forest and skyward over hills 1000 feet in height to a destination some 3000 miles distant.

During winter months north of the equator one may expect reliable communication over a distance of 4000 miles with 150 watts of H.F. power at approximately 3750 K.C. During the summer months it will be necessary to increase power to 500 watts to cover this same distance. Greater distances may be covered with less power during daylight on ultra-short waves.

Observation on Atmospherics.—After close observation of meteorological conditions covering a period of six months, nothing could be associated with favourable and unfavourable conditions of radio reception. It was shown that the presence of high ground winds brought about increase of atmospherics. It is believed that dust particles stirred up into motion are the principal causes of this atmospheric increase. The static or atmospherics were of the regular "grinder" variety. The receiving circuit herein before described was particularly advantageous in reducing this species of static. Instead of a static train being heard in the telephones for a period of the duration of its pulses, it was reduced to simple sharp clicks.

"Wave jumping" is the term applied to a phenomenon noted on two occasions in Brazil. After thirty minutes of trying to "raise" an American station from a point on the Uraricoera called Cujuma, the operator was surprised to hear a Canadian station calling. After communication was established the Canadian operator explained that he had been unable to communicate with the U.S.A. for a week. Here was a perfect example of radio-energy on short wave-lengths completely jumping the U.S.A. from points north and south. Two hours later stations in the U.S.A. were worked in the usual manner.

After the expedition had returned to Boa Vista, Rio Branco, the base station attempted communication with the U.S.A. after an absence of one month during travel down-river. Three nights and mornings were devoted to intermittent calling and listening, but no stations could be heard except a faint signal from the "carrier frequency" of a broadcast station at Pittsburgh. One night at 8 p.m. 60th M.T. this carrier was a bit louder and gradually increased in strength up to 10 o'clock. This rather encouraged the operator, and at 12 p.m. a station in Philadelphia was worked and acknowledged receipt of 300 words of traffic. This phenomenon was only experienced during the summer months north of the equator. During the winter months consistent communication over a range of 4000 miles could be expected from a transmitter having an output of 150 watts at 7500 K.C.

Effect of Daylight on Short Waves of 80 Metres.—Absolutely no difference in night or daytime signal from portable station sending over a distance of 200 miles was noticed at the base station. Transmission took place at 10 a.m. and 8 p.m., 50th M.T.

An excellent opportunity for observing daylight effect on radio signals was afforded on 18 January 1925, when WJS (base station) held communication with 9ZT at Minneapolis, Minnesota. Communication was established at 4 a.m., 60th M.T., and continued until 6.40 a.m. During this time it was possible to observe the sun rise while receiving signals on approximately 80 metres from 9ZT. This was an excellent example of both stations working through partial daylight, and the only effect perceptible was a superb clarity of the received signal after the sun had risen. Results on long waves of 7000 metres from NBA Balboa, Panama, show a 60-per-cent. decrease in signal as daylight comes over the 60th Meridian.

Experimental work with ultra-short waves to-day shows that certain frequencies must be employed at certain times during daylight and darkness to obtain greatest efficiency in transmission. The 46-metre wave, 7500 K.C. has been found to work best during daylight. The range of transmission on other frequencies appears to depend entirely on the relative position of the sun.

EXTRACTS FROM REPORT OF CAPT. A. W. STEVENS, U.S. AIR SERVICE, TO CHIEF OF AIR SERVICE, WASHINGTON, D.C.

The recent expedition achieved greater success than usual, because improved apparatus was taken, capable of modification to the use of short waves. With this light field outfit 100 and 200 word messages were sent to and received directly from London, England, and communication was established regularly at night with practically all points in the United States, from New York to San Francisco. Although located in the heart of the world's greatest forest, the apparatus was so efficient that the signals it sent across thousands of miles of jungle and ocean were reported all over the United States as being "very strong." In another direction, a point as far distant as New Zealand was sent to and heard from, although the messages in this case were brief.

Before the expedition proceeded up-river a test was made of a ¾ K.W. tube transmitter to determine how far messages could be sent with this small outfit. This test was carried out at the City of Manaos, and messages were sent at night to the town of Santarem, approximately 400 miles east of Manaos, on the Amazon River. The station at Santarem was called, but did not reply. An operator on watch at Manaos reported that Para, 850 miles east of Manaos. was calling the expedition station at Manaos to report reception of signals from the ¾ K.W. tube set. Communication was then started with Para, and several messages were sent and received without difficulty over a distance of 850 miles. At this time an unsolicited report from the operator at Para stated that the signals from the expedition's ¾ K.W. tube set were more readable than the signals from the Manaos station using a 40-K.W. spark set.

At the station of Boa Vista the 360-metre wave from KDKA, Pittsburgh, could not be heard, using a receiver consisting of one stage radio detector and one stage audio amplification, while the 62-metre sent simultaneously was received in good strength to the extent of enjoying the music. It is to be understood here that conditions here create the worst possible output to the transmission and reception of electric magnetic waves. While broadcasting stations in the United States have been reported many miles more distant than the Boa Vista location, they could not be received with a standard arrangement

of three tubes. It is interesting to note that ocean-going steamers travelling up and down the Amazon River do not use their wireless apparatus until they get to the Atlantic Ocean, partly on account of the difficulty of receiving and sending signals over the forest with the long waves customarily used.

Short Waves.—Realizing the possibility of short-wave communication, a receiver and transmitter were constructed and put in operation December 1924, and communication established with amateur station 2CVS New York. Since that time signals have been exchanged with the following distant stations:

Station.	*Date.*	*Time.*	*Location.*
2CVS	14–12–24	12 a.m.	New York City.
6OI	15–12–24	5 a.m.	Stanford Univ., Cal.
2AP	24–12–24	4 a.m.	Wellington, New Zealand.
1COT	26–12–24	12 a.m.	Braintree, Mass.
5SK	9–1–25	11.30 a.m.	Fort Worth, Texas.
1AB	14–1–25	4 a.m.	Rio de Janiero.
6CHL	15–1–25	2.40 a.m.	San Francisco, Cal.
9ZT	18–1–25	6.40 a.m.	Minneapolis, Minn.
2NM	19–1–25	3.40 a.m.	Caterham, Eng.

Time is 60th Meridian West.

All stations, with the exception of Rio de Janeiro and New Zealand, have reported signals from this station as being VY QSA (very loud). This was accomplished with 180 watts energy output at 356·2 K.C. One instance of working through partial daylight is the exchange of signals with station 9ZT in Minneapolis, 6.55 a.m., 60th Meridian. 9ZT called just as 2MC New York had finished sending to this station WJS, so that both stations were worked in daylight, and signals from this station were reported loud and strong at 9ZT and 2MC. It must be remembered that atmospheric disturbance is maximum at night and always very strong in this part of the country, but short-wave signals may be copied during all hours between 6 p.m. to 7.30 p.m. Those received after 7 a.m. are usually from west coast and middle west of United States.

After six months of observation, only high wind can be associated with the increase of atmospherics. Clouds do not affect conditions for reception; although the entire sky visible may be formed into nimbus clouds, no perceptible effect has been observed. Therefore the tremendous advantage of short waves can be readily estimated for use in consistent communication, especially in tropical countries.

Most efficient reception of the short waves is obtained by using an insulated wire between 30 and 40 feet long, pointed in direction of station to be received, and either buried or placed on the ground. The receiver consists of only three tubes (Fig. 4).

For transmission, antenna constructional cost and time are exceedingly small, compared to that of long waves for a given distance of communication. It is particularly adapted to mobile stations, having a limited space to erect antenna, particularly aircraft.

Equipment: Receiving.—Utilizing a stage of radio-frequency amplification in which regeneration of the original signal is obtained by the "tuned plate" system, the elimination of the usual coupling coil to transfer energy from the amplifier to the detector for rectification by taking advantage of the high-voltage drop across a parallel resonant circuit of low resistance at a resonant frequency, a stage of audio frequency amplification to amplify the rectified signal—one stage only to be used where atmospherics are strong. [Printed as received.]

A slight increase of signal and perceptible decrease of static is obtained by connecting antenna on plate of detector. Closer coupling may be used, the " feed back " effect of the coil L3 compensating increase of resistance (Fig. 4).

Transmitter.—A persistent oscillator may be made by the use of a circuit developed at this station called a momentum circuit, consisting of a small inductance and large capacity, thereby obtaining a low resistance circuit and very large currents flowing therein. The action of this heavy current flowing is to offset any shifting phase in plate circuit due to D.C. current flowing therein to plates of tubes. Secondly, it has the effect of a flywheel in motion when the driving member meets with resistance.

This circuit very nearly determines the frequency of the emitted wave. It is disturbed slightly by adding antenna capacity (see Fig. 3).

By drawing this circuit differently, we have one that is ideal from the point of view of power transference [diagram not reproduced].

The tube is replaced by an alternator feeding a parallel circuit of low resistance L1 C1. The impedence of this is maximum at its resonant frequency. Across this is connected the circuit to be supplied, namely, the antenna, which is a series resonant circuit offering minimum impedance to the frequency to which it is attuned, and by adjusting L2, C2 so that its period is equal to that of L1 C1, we have the following ideal conditions.

A supply circuit having maximum impedance to a frequency determined by its L1 C1 values, consequently having a very high voltage drop across its terminals, to which is connected a series circuit L2 C2, offering minimum impedance to the frequency to which it is attuned, in this case the frequency of circuit L1 C1, which by virtue of working it about 20 per cent. below its fundamental contain high radiation resistance.

Primary Power Supply.—Delco 1½ K.W. generating plant, battery unit of 120 volts, 80 ampere-hour capacity. Due to desirability of a light weight unit, the batteries could only have a maximum of 80 amperes, but by floating the Delco generator across them the current drainage is equally divided so that batteries are not abused. This system had been in operation approximately eight months, running ten hours per day and unfailingly delivering 7·33 K.W. hours per gallon of kerosene and pint of lubricating oil. A 3 h.p. motor generator delivering 1000 volts at 1·2 amps. converts the low potential supply to power suitable for the input of the transmitter.

Field Station.—The field station, or portable canoe outfit, was operated as follows :

A " Caille " single-cylinder canoe motor was used to drive an automobile generator, which charged a storage battery. The motor was left attached to the end of the canoe, but the canoe was drawn out of water until only the stern remained immersed. The motor then ran uniformly, with the propellor acting as a brake, and received its cooling water from the river. A V-shaped rim had been bolted to the fly-wheel, and from this V pulley a belt ran to the auto generator. Thus it was only a moment's work to start charging the battery after landing for a camp. Later in the evening, or in the early morning hours, the battery and generator together delivered current to a small motor generator, which delivered current of higher voltage to tube set. For receiving, the motor was shut down because of noise, and battery only used ; this involved keeping an extra man up to start and stop the motor on signal from operator.

The same motor was used for propelling the canoe, wherever clear stretches of water were available ; at other times the canoe was paddled, poled, pulled, or carried.

From consideration of size and portability, the field station was limited to a power output of between 25 and 50 watts, this being sufficient power for reliable communication on short waves to distances up to 200 miles day or night.

The practice was to send messages from the field station to the operator at the base station at Boa Vista, where it was easily possible with a power output of one-fifth K.W. to reach either England or the United States, the operator at base copying and re-sending.

Comparison: Short and Long Waves.—After station WJS had been in operation for four months, weather conditions caused frequent interruptions in communication between Boa Vista and Manaos, a distance of 400 miles. Up to this time work had been confined to present long-wave transmission and improvements on antenna system.

On December 10 a short-wave set of about 100 watts output was put in operation and a New York station worked. This was the beginning of a very efficient link in communication.

With original arrangements, amateur stations in New Zealand, England, and United States were worked. Later, by increasing the output power to about 150 watts, uninterrupted communication was conducted with New York in spite of extremely adverse tropical weather conditions.

Another link in communication was added when messages were exchanged with England. This gave WJS at Boa Vista, Brazil, lat. 2° 49′ 17″ N., long. 60° 39′ 45″ W., direct communication with New York and London, and from both places signals from this station were reported as being very loud and consistent.

Had there been more than one operator at the base station, regular service direct between any of the cities in the United States and important cities of the world, such as Rio de Janeiro, Buenos Aires, and London, could have been maintained.

Obviously, with those numerous routes to handle traffic as compared to the one, viz. Manaos on long waves, the supremacy of short waves is proven.

Apparatus.—Primary source of power consists of a Delco 1¼ K.W. unit and battery of 80 ampere-hour capacity. When large long-wave transmitter is used, it is floated across line to take up excessive drain on battery.

Long-wave transmitter having an output of ½ K.W., and made in two separate units, inductance, and set including tubes, etc., both mounted on detachable legs for supports. With this circuit shown in print [not reproduced], advantage was taken of the property in a parallel resonant circuit at its natural frequency and the high voltage drop across its terminals due to heavy circulating current in L1 C1 having low inductance and high capacity resulting in a low-resistance circuit having a maximum impedance at its natural frequency. An antenna of suitable characteristics was directly connected across the terminals Antenna and Earth, and no increase in efficiency was noticed when antenna was tuned. The natural period of the antenna was within 40 per cent. of the working wave.

This circuit L1 C1 had determined the frequency of the transmitted wave and prevented any trouble with grid period affecting frequency. This was particularly advantageous for a semi-permanent antenna having average resistance of those constructed hurriedly in the field.

Short Waves.—A small power set having an output of approximately 150 watts is shown in Fig. 3. This is a "tuned plate" circuit, and takes advantage of coupling to a portion containing very large currents; in this case

the antenna circuit is tuned. The long-wave antenna was excited at one of its harmonics, and proved to be an exceptionally good radiator on 93 metres.

Receiver.—This utilizes the tuned plate system of regeneration, and again advantage is taken of the high voltage drop across the terminals of a parallel resonant circuit at the frequency determined by its inductance and capacity. Selectivity is afforded by virtue of a decreased signal for other than the frequency to which circuit is attuned (see Fig. 4).

The antenna, which consists of about 30 feet of insulated wire, is laid on the ground in direction of transmitting station, and is connected to the plate of the detector, thus transferring energy through the tickler coil to the radio frequency amplifier.

A reduction of static is accomplished by connecting the antenna to plate terminal of the detector tube. Due to the reduction of static greater signal energy may be transferred to the radio frequency amplifier by closer coupling of L3 to L1. The added antenna resistance due to closer coupling is compensated by feed-back action of tickler coil. Thus it may be seen that this tickler coil L3 has many uses, but principally that of changing the signal-static ratio.

In conclusion, it has previously been supposed that stations near the equator were exceptionally poorly located for regular communication, because of static and other troubles. The Boa Vista station was less than 3° from the equator; it was about 300 feet above sea-level; it was surrounded by many hundreds of miles of dense tropical jungle. In spite of these difficulties, and the fact that it was possible to erect an antenna only 80 feet above the ground, the station apparently got better results than many other stations more favourably located and that had far more power output. One feature to be noted is that stations in Great Britain said, "Your signals are very strong; we have been hearing you every night." New York reported, "Very strong signals."

Amateur stations were communicated with on short wave, as against professional stations on the long wave. Many of the amateur stations reached in the United States were located at colleges, and operated by students interested in radio. Other amateur stations were worked by enthusiasts connected with radio supply houses; still others were worked with privately owned outfits. In all cases the amateurs worked in connection with a radio league, and there was fine cooperation in getting messages forwarded to any point desired. Advantage was taken to send messages *via* New York to the Chief of Air Service at Washington. Messages were sent to the American Geographical Society in New York very regularly, and replies were received regularly; long messages were sent to the Royal Geographical Society through amateurs in England. Many messages were sent to families of members of the expedition, scattered all over the United States, assuring them at Christmas time that all was well with the expedition.

Supplies were ordered by wireless; in several cases the order was wirelessed to New York, then cabled back to Manaos, to be shipped from Manaos up-river to Boa Vista and other up-river points. This was necessary whenever long-wave communication could not be held direct from Boa Vista to Manaos. From the experience gained on this recent trip, it is certain that another expedition will depend wholly for communication on wave-lengths of 80 metres or less.

THE JUBILEE OF THE REAL SOCIEDAD GEOGRÁFICA OF MADRID

THE *Real Sociedad Geográfica* celebrated the fiftieth anniversary of the date of its foundation during the week March 25–31 last. Invitations were issued to the Geographical Societies of other countries to send delegates to take part in the celebration, and the Royal Geographical Society was represented by the writer of this account.

The original title of the Society was *la Sociedad Geográfica de Madrid*. It was founded as the result of a meeting which took place on 2 February 1876, presided over by Excmo. Sr. Conde de Torreno; the meeting was called together by D. F. Coello, D. E. Saavedra, and D. J. M. Macanaz, and was attended by some of the most eminent men of science and letters then living in Madrid. It was then decided to found a geographical society, similar to those which already existed in most European countries. The actual date of the constitution of the society was March 27. In 1883, on the initiative of the above Society, there was founded a *Sociedad de africanistas y colonistas*, which subsequently took the name of *Sociedad española de Geográfia comercial*, and this was incorporated into the parent society in 1896.

Later on, the importance of the activities of the Society was appreciated and recognized by the Spanish Government. By a Royal decree of 18 February 1901, Excmo. Sr. D. Antonio Garcia Alix being the Minister of Public Instruction, the name was changed to *Real Sociedad Geográfica*, and a sum was placed in the estimates as a subvention to the Society. The new statutes were approved at a general meeting, and were published in the *Gaceta de Madrid* on 18 August 1901. The Society has thus a complete official status, and is under the general supervision of the Ministry of Public Instruction. The Patron is the King.

The present strength of the society is about 200. The existing President is Excmo. Sr. D. Francisco Bergamin, a former Minister of the Government; the General Secretary is Excmo. Sr. D. R. Beltrán y Rózpide. The Council (Junta Directiva) includes some well-known geographers, and is admirably representative. The Council is also the National Committee for Geography, under the statutes of the International Geographical Union, and, in that capacity, is divided into sections dealing with topography and cartography, physical geography, human geography, economic geography, historical geography, biological geography, with a section for Propaganda and International Exchange.

The Society shares its rooms with the Real Academia de la Historia. These rooms, which are in the Calle del León, are convenient and comfortable, and include council and committee rooms, and a good hall for general meetings, holding two or three hundred. Certain of the members of council are also members of the Academia de la Historia, and this and the common occupation of the rooms may, perhaps, give a

somewhat antiquarian and historical tone to the proceedings of the society, not, however, to the exclusion of other aspects of geography. The society publishes a well-known quarterly *Boletín*, which runs to some 500 or 600 pages in the course of a year.

Representatives of the R.G.S. and of the Geographical Societies of Italy, Holland, Portugal, Finland, and other countries attended the celebrations, which began with a lunch of the Junta Directiva and their guests, the foreign representatives, at the Palace Hotel, on March 25. On the evening of the same day there was held a special public meeting at the hall of the Society, presided over by the Minister of Public Instruction. The representatives of the foreign geographical societies presented their addresses of congratulation. After this, brief speeches were made by Sres. D. Antonio López Sánchez, D. Emilio Zurano, and Excmo. Sr. D. Luis Palomo, on *Geography and Spanish Geographers in the Nineteenth Century*. The Minister, Señor Callejo, in an eloquent speech, congratulated the Society on the completion of its first fifty years of existence, and pointed out that the science of geography in Spain had a very ancient ancestry, mentioning Seneca, San Isidoro, the schools of Cordoba and Toledo, in which Eastern and Western learning were united; kings, such as Alfonso X. and Philip II., and in more modern times the founders of the Society and their successors.

The morning and afternoon of the 26th were devoted by the visitors to sight-seeing; in the evening a special lecture was given at the Circulo de la Unión Mercantil y Industrial by Professor D. Victoriano Ascarza, of the commercial section of the Society, on the application of the cinematograph to the teaching of geography. On the 27th an excursion, in honour of the foreign delegates, was made to the wonderful old city of Toledo, an excursion very much appreciated by those delegates. It included visits to the Alcázar, now the academy for infantry cadets; the house of Cervantes; the church of San Juan de los Reyes; the fifteenth-century synagogue in the Moorish style, now known as Santa María la Blanca; the house of El Greco; and the magnificent thirteenth-century cathedral. On the evening of the 29th there was a full-dress meeting at the rooms of the Society; Sr. D. Miguel de Asúa y Campos delivered a discourse on the work of the Society. Two Ministers were present, and D. Miguel's speech was followed by one by the President, which was much applauded by the audience.

On the 30th the writer was taken by Sr. D. J. M. Torroja to see the two Zeiss machines belonging to the Sociedad Estereográfica Española. This stereophotogrammetry is beginning to be a commercial proposition. The company in question is engaged in making plans of Bilbao, by this means, on the scale of 1 : 25,000. The method is also beginning to be used in Spain, as it is in Germany, for the construction of plans and sections of existing buildings, an interesting and curious application of the system. Later in the day the committee and delegates spent a very

instructive hour or two at the official Instituto Geográfico under the courteous guidance of the Director. Here, as elsewhere in large cartographic establishments, the use of copper is being entirely given up, and a system very similar to our helio-zincographic process is taking its place. Good progress is being made with the Spanish sheets of the International Map.

The official celebrations came to an end the same day with a banquet at the Palace Hotel.

The writer would like to take this opportunity of expressing his thanks to the President and Junta Directiva of the Real Sociedad Geográfica for their hospitality and courtesy to the foreign delegates; in particular he feels much indebted to Excmo. Sr. D. General S. Gomez Núñez and to Ilmo. Sr. D. Julián Diaz Valdepares, for their daily attention and constant kindness during a very instructive and interesting week.

C. F. Close.

HAWKINS' MAIDEN LAND AND THE FALKLAND ISLANDS

A Reply to Mr. Henniker-Heaton by Vice-Admiral B. M. Chambers, C.B.

IT is curious that after an interval of a full quarter of a century my little article which appeared in the *Geographical Journal* for April 1901 should be arousing interest. In six months I have met with no less than three references to it—the last being Mr. Henniker-Heaton's article in the *Journal* for January 1926. After reading his remarks I am quite unrepentant, and though I still find many irreconcilable points in Hawkins' account, I hold in the main to my original finding: (1) That Hawkins' Maiden Land was not the Falkland Islands; (2) that the land he saw was the outlying bit of coast on the main, beginning at Cape Tres Puntas and ending 60 leagues further south. Mr. Heaton gives me the credit for being the first to enunciate this theory, but he might have seen by reference to Hawkins' voyages in the Hakluyt Edition that Sir Clements Markham had very grave doubts on this very point in the year 1878, and he remarks in a footnote that the land on the coast in 48° projects to the eastward, and might well be that which was seen by Hawkins.

In my article I had to assume that Hawkins made an error as to the general lie of the coast, taking it as E. and by N. instead of N. and by E., and that he had fitted in the other points such as larboard for starboard to match. It is easy to make such a mistake writing many years after the event, and if this change be accepted the whole of the facts fit in with remarkable exactitude. Mr. Henniker-Heaton has to assume a

good many more errors and discrepancies before he is able to get his facts to fit in with the assumption that Hawkins did really see the Falkland Islands.

By a curious coincidence it was but a few weeks ago that Fitzroy's account of his surveys in the *Beagle* came into my hands. My interest in the whole matter had been awakened by a reference to my theories in Boyson's 'Falkland Islands.' I therefore turned up my article and re-read it by the light of Admiral Fitzroy's description of that part of the coast. I have unfortunately returned the book to its owner, and am not able to quote from it, but the description of Cape Tres Puntas is very illuminating.

To return to Mr. Henniker-Heaton's theory: I hope he will forgive me for saying that he does not deal with the problem from the point of view of a seaman and navigator. On p. 55 he evidently imagines that the storm experienced drove Hawkins to the south, and he estimates that driving under bare poles he made 7 to 8 knots. This is rather a high estimate, but it is immaterial, since the storm did not drive him to the south, but to the north. In the 'Hawkins' Voyages' it is thus described: "In the height of the river of Plate, we being some 50 leagues off the coast, a storm took us southerly which endured 48 hours." He goes on to tell how the *Fancie*, his consort, at the going down of the sun "bare up" before the wind. Hawkins bore up after her and made light signals, "*but she never answered them for they kept their course directly for England.*" This shows that the gale was from the south, and *not a gale driving them to the south.*

On p. 186 Hawkins says, "Within 16 hours the storm ceased [this probably means after they abandoned the chase of their consort] and the wind became fayre, which brought us to the Straites and dured many days with us at N.E. . . . We made account that they had been swallowed up by the sea. The storm ceasing and being out of all hope, we set sail and went our course."

If any one will plot the position of the ship and then shape course with a fair wind for the Straits it will be seen how extremely unlikely it would be that they would ever go near the Falkland Islands, and how very probable that they would make Cape Tres Puntas.

The gale they experienced was almost certainly a Pampero, and from my own logs I find that two experienced in 1883 blew from S. by W. in much the same locality. In both cases the southerly gale was followed by a N.W. wind, whilst Hawkins speaks of the wind as N.E., though it seems afterwards to have gone to the W. or perhaps N.W.

Any one who reads Hawkins' voyages critically will see that they are put together from other documents and are pieced together more or less at random. I am inclined to believe that the paragraph of nine lines, p. 188, beginning "the wind continued good," should come in after the description of Hawkins' Maiden Land. The dragging in of Port St.

Julian is curious. He did not visit the port, but it was in his mind, and it was close to this port that he must have abandoned his coasting.

According to my theory Hawkins, making direct for the Straits, sighted Cape Tres Puntas in 47° 5′ S. (*i.e.* next of anything 48°). The wind, which had been N.E., came to N.W., and he came to the wind on the starboard tack and stood along the coast to the S.W., exploring 60 leagues of coast.

At the end of the 180 miles the wind was still fair for the Straits. He would have had land in sight all this time, and would then lose it. He would have just another 60 leagues to go to make Cape Virgins—St. Julian was the place where he began to doubt.

There are four cardinal difficulties in the way of accepting the Falkland Islands as being Hawkins' Maiden Land. I will place these in series, as does Mr. Henniker-Heaton on p. 57 of his paper.

(1) Hawkins says that he explored 60 leagues of coast on a line E. and by N. and W. by S. There is no such coast in the Falkland Islands, nor anywhere else in those parts.

(2) Hawkins saw inhabitants and many fires. Though one fire is possible in the Falklands, many fires is out of the question. There were no inhabitants.

(3) After sailing along the coast for a night and a day to the N.E. (? S.W.)—*i.e.* away from his object, which is most unlikely—he would, when he turned back, have had to run some 440 miles before he could reach the Straits. He made the distance only 180 miles. Mr. Henniker-Heaton remarks that Frezier only made it 200 miles, and that other early navigators estimated it at even less. It is not, however, the estimated distance but the actual distance which counts, and this was 260 miles.

(4) I have, however, reserved the most important point for the last. I have always regretted that I did not emphasize it in my original article.

If Hawkins stood to the N.E. along this discovered coast for a day and a night for near threescore leagues, how is it that we hear nothing of his seeing the coast upon the return journey?

I absolutely fail to see how he could have avoided passing along this coast on his return and making a fresh set of observations on distances, etc. We should have heard of his taking his departure from the three-peaked point and steering thence for the Straits.

Putting aside all other things and assuming that Hawkins did what he ought to do, everything fits in—except that he was naturally puzzled to make the bearings fit in, and cooked them by turning them about.

I hope that I may be forgiven for so long a discussion, but I have seen a letter by Mr. Henniker-Heaton in which he hopes to elicit a reply from myself. I have therefore written the above.

REVIEWS

EUROPE

Roman London.— Gordon Home. London: Ernest Benn, Ltd. 1926. 8½ × 5½, pp. 260. *Sketch-maps and Illustrations.* 15*s. net.*

In spite of the work of such predecessors as Mr. Reginald Smith, Mr. Lethaby, Sir L. Gomme, and others, the history of Roman London is still capable of fresh treatment, just as there is still room for a more complete and better set-out collection, in one place, of Roman objects found in London. As in 'Roman York,' so in this book the laudable object is to give the life of one town a setting in what is known of the history of Roman Britain. The author has with considerable pains collected and systematized practically all that is known, not laying too much stress on the archæological details of his subject, but presenting the human side by a full use of his somewhat exceptional power of visualizing the details of the life lived fifteen to eighteen centuries ago. In his pages appears much imaginative reconstruction, but it is of the sober sort inferred cautiously from facts—in short, "imagination juste." The shrewd guess is everywhere in evidence. No doubt history and archæology are mainly concerned with fact and well-documented evidence; but pictures drawn by the inductive faculty are equally necessary to an advance in our knowledge of Ancient Britain. Herein lies, we take it, the chief value of Mr. Home's book.

Very helpful are the numerous diagrams and maps such as those illustrating the marches of Cæsar and Aulus Plautius and the surroundings of Roman London within a 25-mile radius: the line drawings and photographic plates are all excellent in their way, and Mr. Foord's chronological tables of Britain and of Londinium, similar to those in 'Roman York,' are of the kind that students of Roman Britain should have ready to hand. We share Mr. Home's high estimate of Mr. Foord's 'Last Age of Roman Britain,' especially in relation to his caution in accepting the usual conclusions about dating from coin finds.

Mr. Home favours Chelsea as the place of Cæsar's crossing of the Thames, and stresses the view which archæology increasingly bears out, that in the period between Cæsar's departure and the Claudian invasion Britain made great strides towards political unification (especially under Cunobelinus), economic prosperity (as evidenced by Strabo's lists of British exports to the Continent), and comparatively rapid Romanization. London, in his view, was a busy commercial centre and practically the capital by A.D. 60; it was the base of the Claudian northward operations, and was then comprised in the area between the Wallbrook and the Fleet, with the site of St. Paul's as its centre. In the third century London with its 350 acres had a population of about 50,000, apart from the Southwark suburb. As to the date of the London Wall no definite conclusion can be reached, but it was built probably not before 300, and perhaps in haste after the disaster of 367. When, about 350, the city became Augusta, it had a population of about 100,000 and was smaller therefore than only some twenty cities of the Empire. On Mr. Home's showing it is reasonable to suppose that during the first decade of the fifth century London must have played an important part, and that it remained in touch with the Roman Government till about 440, the influential capital of an important province. The probable date of the change from Roman London to English London is *c.* 570. "That continuity of life within Londinium was maintained throughout the Dark Ages seems to me to be a fact." The ingenious reconstruction (Chapter XI.) of London in the second

half of the fourth century is very interesting reading, and typical of the author's method. S. E. W.

The Cairngorm Hills of Scotland.— Seton Gordon. London: Cassell & Co. 1925. $9\frac{1}{2} \times 6\frac{1}{2}$, pp. xii + 220. *Map and Illustrations.* 15*s. net.*

The Cairngorm Hills rise from the highlands of Central Scotland, though they were not always known by their present title, for that was only held by the individual point which still bears the name. Formerly they were styled Monadh Ruadh, or Red Mountains, as opposed to the Monadh Liath, "Grey Mountains," that bound the western ridge of the Spey valley. Although their highest peak, Ben Mac Dhui (4296 feet), is lower by 110 feet than the loftiest mountain in Scotland (Ben Nevis), it is nevertheless a noteworthy fact that the Cairngorm Mountains display a greater area of hill country reaching a height of 4000 feet than any similar mountain region in the whole of the Highlands. Here four peaks overtop that altitude, namely Ben Riach (4248), Ben Mac Dhui (4296), Cairn Toul (4241), and Cairngorm (4084). It is not, however, the tallest of these that is the most imposing, for it lacks the grandeur both of Cairn Toul and Ben Riach. There is at least a note of distinction hidden in its name, of which the older Gaelic form, Beinn Mac Duibh, stands for "The Hill of the Sons of Duff." It appears that MacDuff, Thane of Fife, in the thirteenth century made a gift of the parish of Inveraven in a charter, and in all probability some part, at least, of the mountain stood on his domain.

An unknown writer in MacFarlane's 'Geographical Collections,' vol. 3, speaks quaintly of "Kairne Gorum, a famous hill which is *four miles* high. Gold hath been found here. The hill aboundeth with excellent Crystall. There is much telling of a Spirit called Ly Erg that frequents the Glen More. He appears with a red hand in the habit of a Souldier, and challenges men to fight with him as lately in '69 he fought with three Brothers one after another who immediately dyed thereafter."

In the volume reviewed the author discourses with much minuteness and considerable charm on the mountains and corries, the glens, lochs, and forests of a very picturesque Highland region. Interwoven with his descriptions he gives a good deal that is quaint and informing in the matter of folklore, legend, and history, and not a little of interest, also, concerning the natural history and the botany of the hills and the dales. In his Foreword he makes grateful acknowledgment of his indebtedness to Dr. W. J. Watson, Professor of Celtic Languages at Edinburgh University, for his valuable revision and correction of the Gaelic place-names that occur in the book. The task must have been indeed a formidable one, for in the index those under the heading of "Coire" alone amount to over forty, and, with others in a similar proportion out of a total of some 500, produce results almost as annoying as they are confusing. Still, some of the old Gælic rhymes quoted, proverbial and otherwise, are of unusual interest. Then we have a graphic account (by Barclay) of a deer-drive in 1563, for the entertainment of the Queen of Scotland, when the "beaters" were charged by the terrified deer with such irresistible onset that their only hope of safety lay in throwing themselves flat on the ground and allowing the herd to run over them. Even so, however, it had to be announced to the Queen that several of the men had been trampled to death. We are told that the last wolf ever seen in the Forest of Mar was supposed to have been killed a mile east of Derry Lodge, about the year 1650. Curious cases of strange feeding on the part of the stags in snow time are recorded, as at p. 211, where one hungry and weary animal, after much fruitless foraging, finds relief in the

remains of a salmon abandoned by an otter. An interesting feature of the fauna and flora of the region lies in the numerous parallels that can be made out with those of the Northern Alps of Japan at an altitude 5000 to 6000 feet higher and in latitudes 20° nearer the equator (cp. ' Playground of the Far East,' Murray, 1918).

A word of praise must be added for the many excellent photographs which really do serve as illustrations. Of these, the Golden Eagle at her eyrie with her tiny eaglet, an arctic scene in March on Loch Eanaich, midsummer icebergs on Loch Coire, and the red deer calf on the Great Moss, deserve special mention. W. W.

ASIA

Quer durch Afghanistan nach Indien.— Emil Trinkler. Berlin: Kurt Vowinckel. 1925. 8×5½, pp. 234. *Sketch-map and Illustrations.*

Until recently, Afghanistan has remained a more or less forbidden ground to European travellers. The raising of this embargo within the last few years will doubtless result in a series of books of which Dr. Trinkler's is but the first. In Kabul in 1924 he encountered numerous fellow-countrymen—doctors, engineers, and architects of the new town and palace of Darulaman—and also Italians, while he himself went thither as geologist to a German trading company. The scientific results of his journeys have been published elsewhere, and this book is purely a record of travel and impressions. He confesses to have always been under the spell of the East, and consequently writes with enthusiasm of all he saw. Approaching Afghanistan from Russian Turkistan, after a delay of seven weeks through official obstruction, he journeyed from the railhead at Kushk over the Ardewan pass to Herat, where he prepared for the more arduous journey by the little-known route up the Heri-rud valley and over the Scharak-Kushta pass to Kabul—a journey made late in the season just before the passes were closed by snow. For days his diary is concerned with the scenery of the desolate, heavily eroded mountains, unrelieved by vegetation. Kabul he found a sea of insignificant houses, which with its more cosmopolitan bazaar contrasted with Herat, a forlorn city of ruinous mosques and palaces. From Kabul, at the request of the Emir, he visited the western flanks of the Hindu Kush to prospect for coal and iron. Since he is a geologist, Dr. Trinkler's photographs convey strikingly the characteristics of this contorted and forbidding country. Before leaving for Peshawar and India, he spent some exciting days at Kabul when domestic strife and Russian intrigue were rife, an experience which later enabled him to appreciate to the full the order reigning across the frontier. The concluding chapters give his impressions of a rapid visit to some of the famous places of India, and in these he shows himself appreciative of the appeal of its ancient culture, though in rather a conventional manner.

G. R. C.

AFRICA

Geology of Egypt. Vol. 1. The Surface Features of Egypt, their Determining Causes and Relation to Geological Structure.— W. F. Hume, with preface by **Col. H. G. Lyons.** Cairo: Government Press. 1925. 10½×7, pp. xliv.+408, *with* 122 *Plates and Geological Map.* ***P.T.*** 50.

It has been fortunate for Egypt that Col. Lyons is a geologist. In his early days at Aldershot he read two papers on the Bagshot Beds before the Geological Society, and when in later years his military duties led him to the Oases of Upper Egypt he took the opportunity of making geological observations

which were afterwards communicated to the same society in a very interesting paper published in 1894. Accordingly, when the need for geological investigation became apparent to the Egyptian Government, it was natural that Lord Cromer should turn to him for a report upon the question; and it is mainly owing to his representations that the Egyptian Geological Survey was established in 1896. He himself was Director for some thirteen years. Dr. Hume, the present Director, joined the Survey in its second year, and in the course of his work has visited every part of the desert from the Oases to Sinai and from the Cataracts to the Mediterranean. No one could be better qualified than he is to prepare a general account of the present state of our knowledge of Egyptian Geology. The volume under review is concerned with the physiography of the region, and is to be followed by others dealing with the stratigraphy and the economic geology.

The historical and introductory matter is followed by a chapter on temperature variations and their results; but the greater part of the volume is occupied by the next three chapters, which deal respectively with wind and sand action, the effects of rainfall, and the effects of solution and evaporation.

Amongst the most remarkable features in the region are the great longitudinal dunes or lines of dunes which rise above the surface of the Libyan Plateau. They attain a height of 30 metres, and some of them stretch through seven degrees of latitude. Their trend is uniformly N.N.W.–S.S.E., which is the direction of the prevailing winds throughout the greater part of the year. But the south-west wind which occurs at some seasons is one of the most effective in transporting sand. It cannot be said that the great extent and regularity of these belts of sand have been fully explained. Dr. Hume thinks that the sand is supplied from the Lower Miocene Beds of the northern part of the Libyan Desert, and that in their advance to the south the dunes cling to the slopes of the depression between the Bahariya ridge and the high gravel expanse which separates the northern oases from the Nile. The general trend of the depressions where the longitudinal dunes occur is approximately that of the prevailing wind.

The chapter on rainfall, with its numerous excellent photographs, will perhaps surprise those who have not fully appreciated the protective effect of the covering of vegetation in our own country. The Libyan Desert and the larger oases are remarkably dry. Even in the north, where the rainfall is greatest, the returns from Siwa show only seven rains in the two years 1913 and 1914. In Upper Egypt there may be no rain for years, but there are occasional storms and floods such as that which in January 1901 interrupted railway communication on the Luxor–Aswan line. In the Eastern Desert rains are more frequent and the effects of water erosion are most conspicuous. But they are evident elsewhere, and Dr. Hume gives an interesting account of the various ways in which the different formations have been affected. Some of the flat-floored, steep-sided, round-headed valleys which are here ascribed to the action of water would probably be attributed by Walther to wind erosion; but the photograph reproduced in fig. 86 shows that temporary torrents take part in their formation. The chapter closes with a discussion of the underground water supplies of Egypt.

The travertine deposits of the oases, the Eastern Desert, and other areas, are dealt with in the section on rainfall; but a special chapter is devoted to chemical and physical changes due to solution and evaporation. Amongst the matters discussed under this head are desert films, alkaline deposits, nitrate shales, change of limestone to dolomite, silicification at the surface, and formation of

gypsum, all of them characteristic phenomena of desert regions. The curious hard dark film which in some parts of the desert coats limestone and sandstone indifferently has been attributed to the action of dew. The dew soaks into the rock, dissolving some of the constituents, and when the exterior dries in the sun the water which has penetrated is brought to the surface by capillary attraction and evaporates. Dr. Hume, however, observes that in his experience dew is very rare in the parts where the film is best developed, and he thinks that occasional showers of rain are more important. Further, in some types of desert film this kind of action seems to be excluded by the circumstances of the case, and Dr. Hume suspects that the necessary chemical and physical changes have been brought about by the direct heat of the sun's rays without the intervention of either dew or rain.

The volume is well printed and lavishly illustrated. There are 205 figures, and the majority of these are reproductions of photographs. There is, in fact, no other book that illustrates the characteristic features of desert scenery so completely. A bibliography of Egyptian geology is added, and there is a full index. P. L.

Mount Sinai, a Modern Pilgrimage.— R. Mary R. Dobson, Mus.Bac. London: Methuen & Co., Ltd. 1925. 7½ × 5, pp. 144. *Twelve Illustrations reproduced from Photographs by Dr. Annette Benson and other Members of the Expedition.* 6*s. net.*

In the winter of 1922 the late Miss Dobson accompanied Dr. Rendel Harris, the well-known Oriental scholar, on an expedition to the Convent on Mount Sinai, the object of which was to study and photograph certain manuscripts in the Convent. The party is here described as representing "many different schools of thought," and coming from different quarters of the globe, but all happy together, with "never a trace of bitterness in our lengthy discussions." Simple as the narrative is, it is charmingly written with an experienced traveller's eye to the important points. It gives in its brief pages a great deal of information not popularly known. The Convent of St. Catherine is not, one would suppose, a place for the woman pilgrim. It may well have been a subject of surmize how a party of several ladies could find accommodation within its cloistered walls. "The present regulations allowed no visitors to lodge within the Convent precincts, but the fact that we had no tents constituted a need which outweighed law and custom. We were therefore all of us, ladies included, given accommodation actually in the place itself; and in a short time a set of rooms, including a good-sized dining-room and a kitchen, were made ready for us." Perhaps the fact that Dr. Rendel Harris—himself an old friend of the monks—presented letters of recommendation from the Archbishop, may have made matters easy. The chapters telling of the life of the Convent, its great library, and the gruesome "bone-house," guarded by the clothed skeleton of St. Stephanos the porter (whose photograph is given) are all of special interest. E. W. G. M.

Big Game and Big Life.— J. Morewood Dowsett. London: John Bale, Sons, & Danielsson, Ltd. [1925.] 9½ × 6, pp. 242. *Portrait and Illustrations.* 21*s. net.*

This is an account of the author's experiences in several parts of the world—New Zealand, Canada, Albania, Iceland, and Africa. It is profusely and well illustrated by photographs and a few reproductions of sketches.

The author's acquaintance with New Zealand was in the '80's, and although forty odd years have passed since then, his stories of New Zealand life in those

days would perhaps leave one with the idea that it was rougher and more "woolly" than the reviewer remembers it some years earlier. The anecdotes are amusing, though some of them a little absurd. There is little or no description of the country. When we come to Canada, the accounts of hunting in the West, and notes on the various descriptions of game animals and their habits, make interesting reading. The author knows what he is talking about and says it well. There is little, however, regarding the general conditions of life in the West. The two chapters devoted to Iceland give a rough general description of the island, its mountains, volcanoes, and glaciers, also a short history, but nothing is said about sport.

In the second and larger part of the book we have a general description of big-game hunting, based mainly on the author's experiences in Africa. Here the various chapters devoted to different species, the photographs of big game, and the notes on shooting, are distinctly good; the author obviously writes from personal knowledge, and is a keen observer and a good hunter. The conclusions he comes to as to where to shoot and how to shoot are quite good, being clearly the results of experience, and would be endorsed by all old African hunters.

Speaking of tuskless elephants, he does not mention that there is no more dangerous elephant than a tuskless bull. He gives his opinion that "if a charging elephant is only a few yards from you, you can shoot straight into the eye and this will practically always turn him, when you can step aside and with your second barrel give him the ear shot." This may be good in theory, but when a charging elephant has come so close to you as a few yards it is very doubtful where your bullet may go!

He says, "the African elephant really never lies down, although some hunters say they have seen them so resting." This appears to be incorrect, as, although the reviewer's own experience agrees with the author's, it is clear from the accounts given by Sutherland and other well-known hunters that elephants do occasionally lie down.

Mention is made of the great diminution in the herds of buffalo which used to be found in many parts of Central Africa, and this is correctly ascribed, in the main, to the rinderpest which swept through the continent years ago. The statement that situtunga antelope restrict their feeding to night-time is not quite accurate, for in places where they are not much disturbed they are often to be seen outside the marshes in the early morning. Puku again (spelt "Pookoo" by the author) are sometimes found in immense herds of many hundreds, and not only in small parties of "three or four to half a score."

Taken altogether the book is quite interesting, and in some parts distinctly amusing, though perhaps a little egoistical. A. S.

AMERICA

Colonising Expeditions to the West Indies and Guiana, 1623–1667. Edited by **V. T. Harlow.** (Hakluyt Society, Series II. Vol. LVI.) London: 1925. 9 × 6, pp. xcvi. + 262. *Maps and Portraits. Issued to Members only.*

The Caribbee Islands under the Proprietary Patents.— James A. Williamson. Oxford: Clarendon Press. 1925. 9 × 5½, pp. 234. *Sketch-map.* 12*s.* 6*d. net.*

The two works here noticed treat of the same comparatively ill-explored field of British expansion, and though produced independently, yet by a fortunate chance they are almost exactly complementary. In the Hakluyt

Society's volume there are printed for the first time many unpublished narratives and other documents relating to the colonization of the Lesser Antilles by Englishmen in the first half of the seventeenth century and to the unsuccessful attempts that they or their fellows made at the same time to establish settlements on the Guiana rivers. In his earlier volume on Guiana ('English Colonies in Guiana and on the Amazon, 1604–1668.' Oxford: Clarendon Press. 1923) and his present work on the Caribbee Islands Dr. Williamson treats of exactly the same theme, but he writes as a critical historian, and, drawing his materials from a much wider field than the documents here collected, he places the episodes securely in the setting of their time. With skilful and accurate judgment he clears away many of the obscurities and contradictions that have befogged early West Indian history, and his work should be welcome to all who are interested in the period of England's first great outburst of colonizing activity. He seems to be acquainted with practically every one of the documents assembled in the Society's volume, and he makes considerable critical use of many of them. They form, in fact, the core of his authorities, and this lends added interest to them, so that they appear as what the historian and his readers so often desire in vain, an elaborate appendix of *pièces justificatives*.

It has proved impossible to weave the story into a connected whole, and it still remains, as was inevitable, a series of loosely articulated chapters. The early English efforts at colonization in the West Indies were nothing but the unsystematic enterprises of a crowd of private individuals who were anxious to better their fortunes across the sea. They were financed by speculative London merchants who sought patronage for the schemes among the royal favourites, and paid for the use of their names and their influence in securing grants from the king by the allotment of shares. Such commissions and grants were necessary if the adventurers were to be shielded from charges of piracy, but they were issued almost indiscriminately, and the Crown made little attempt to correlate them or to parcel out the area for which the rival promoters were scrambling. When some of them succeeded in establishing plantations that could produce goods for which there was a market, disputes naturally arose concerning the provisions of their overlapping and inconsistent titles. Some of these disputes, especially in the case of Barbados, led to bitter conflicts and rival appeals to the king's favour. Others were fought out in the courts of law, and Dr. Williamson finds some of his freshest and most valuable material among the ill-explored records of the Court of Chancery. He has thus been enabled to clear up many previously unexplained difficulties and to supply for the first time a reasonably clear account of the early history of the "sugar islands" that were in the eighteenth century to become for a time the Crown's most valued colonial possessions. There was a good deal of hard swearing by the rival claimants, and if we were dependent only upon the narratives printed in the Hakluyt Society's volume, full and interesting as they are, it would be impossible to reconcile them. The Introduction to this suffers from the defects of the material with which it is mainly concerned, and this deprives it of much of the value that the patience and assiduity of the editor deserved. Luckily, the publication of Dr. Williamson's work renders it unnecessary to point to various errors that were possibly inevitable to a writer who had not access to the other sources of information that are now disclosed.

The many explanatory notes contain a mine of biographical information of varied interest concerning the actors in the events described in the narratives. The admirable reproductions of early maps maintain the high standard that we are accustomed to find in the publications of the Society. A. P. N.

POLAR REGIONS

Whaling in the Frozen South.— **A. J. Villiers.** London: Hurst & Blackett. 1925. 9×5½, pp. 292. *Illustrations.* 21*s. net.*

Ross reported right whales in the Weddell Sea in 1842, but it was not until fifty years later that Scottish and Norwegian whalers visited these waters in search of them. The expedition was a failure because the only whales seen were finners, for landing which the ships carried no equipment. The Antarctic expeditions of the first decade of this century drew renewed attention to the finner whales of southern waters, and led to the prosperous whaling industry at South Georgia and the South Shetlands. Captain C. A. Larsen, who originated that industry, looking always for new whaling grounds, turned in 1923 to the Ross Sea. He secured a five years' monopoly from the British Government, which took formal possession of the Ross Dependency for this purpose. Larsen's fleet consisted of a 13,000-ton vessel, which he renamed *Sir James Clark Ross*, as a mother ship and floating factory, and five whale catchers, each of about a hundred tons. The six ships left Hobart for the Antarctic in November 1923. Among the crew of the mother-ship was the author of this volume, a sailor by profession, but clearly also a writer with a capacity for vivid description. Larsen's intention was to use the Bay of Whales, in the Barrier, as a base, but Discovery Inlet, though far from ideal for the purpose, was found to be safer. Blue, fin, and killer whales, but no hunchbacks nor right whales, were seen. The blue whales were very large and well covered with blubber. Of some two hundred that were taken 90 per cent. were over 85 feet in length, and they yielded an average of 85 barrels of oil each. Later in the season a smaller number of the less valuable fin whales was taken. In all some 17,500 barrels of oil were secured before the fleet left the Antarctic, as late as Captain Larsen dared, early in March. Low temperatures and strong blizzards were experienced frequently, while the want of a really safe harbour was a great drawback. A careful examination of the whole coast-line of Victoria Land from Cape Adare to McMurdo Sound failed to reveal one. The factory was equipped for taking hunchbacks and right whales bodily on board, but blue and fin whales were too heavy and had to be flensed as they lay alongside; for this purpose a safe calm harbour was essential. The following year Larsen took his fleet south again with improved equipment and secured almost double the quantity of oil. During this second year Larsen died in the Ross Sea. The volume is full of interest and contains much matter of value in regard to the habits of whales, including an account of an attack on a blue whale by six killers. There are also some chapters on Campbell Island. The illustrations are good, but there is neither map nor index. Some notes on the ice and hydrography of the Ross Sea by the captain of *Star I.*, who examined the coast for a harbour, appeared in the *Journal* in January 1925. R. N. R. B.

GENERAL

Imperial Military Geography.— **Capt. D. H. Cole, M.B.E., F.R.G.S.** 3rd edition. London: Sifton, Praed & Co., Ltd. 1925. 8½ × 5½, pp. 379 + 20 pp. of appendices. *Thirty-five Diagrams and Maps.* 10*s. net.*

The third edition of this useful handbook shows a great advance on its predecessors. The book has been entirely revised, very largely re-written, and considerably enlarged, and the fact that it figures in the list of works recommended by the War Office to officers preparing for the Staff College examination bears witness that its educational value has been officially recognized.

Capt. Cole's book purports to analyse the "general characteristics of the Empire in relation to Defence," and it does so in a way that is both thorough and concise. Although primarily intended for military students, it is a book which might with advantage be studied in every university and school in the country, for no work of the same compass which has hitherto appeared is so well calculated to enable the student to "think imperially," and to gain a well-proportioned grasp of the extent of the Empire, its resources and economic potentialities, valuable alike to the statesman, administrator, and man of business.

After discussing generally the varied climates, frontiers, and resources of the Empire, the author describes at some length the seaways and airways which link up its scattered units. The Overseas Possessions are then described in detail, their different strategic problems and systems of defence being fully analysed. Thus, in the chapter on Canada the transcontinental systems of transport, both by rail and by inland waterway, are discussed from the economic as well as from the defensive point of view. Separate chapters are also devoted to such important strategic subjects as Petroleum, Cables, and Wireless, the Suez Canal, the Middle East, and the North-West Frontier of India. A concluding chapter on Imperial Organization is of special value, dealing as it does with the varying and complex systems under which our Dominions, Colonies, Protectorates, and Mandated Territories are governed and administered. The matter is on the whole clearly arranged, and the book is both documented with appendices and supplemented with an adequate index.

In addition to presenting a mass of relevant information, the author discusses sanely, and yet with considerable boldness, a host of delicate problems which affect, or may in future affect, the course of Imperial policy. Such, for instance, are the intensive trade rivalry between Great Britain and the United States, the expansive tendencies of Japan, the Singapore base, the suggestion to exchange Gibraltar for Ceuta, and the Panama Canal. In this latter connection, however, one may perhaps differ fron the author's contention that the opening of the Panama Canal has diminished the strategic value of the British West Indies. It is a pity that the author could not have found space to discuss also the proposed Channel Tunnel.

It would be surprising if a work of this nature, which is almost encyclopædic in the mass of information presented, were to contain no errors or omissions. These however are remarkably few, and will doubtless be rectified in later editions. On p. 42 the author makes the somewhat bold statement that "no country devoid of satisfactory coal resources can hope to stand in the first rank among the nations of the world," which is signally refuted by the post-war economic expansion of Italy. On p. 41 he seems needlessly pessimistic over the Government's efforts to encourage the growing of sugar beet in this country.

The information given is on the whole up to date, but in some instances it has anticipated the actual facts, as, for instance, in the case of the Paris–Angora air service, mentioned on p. 131. Although this was tried as an experiment in the summer of 1924, it has now been discontinued owing to the difficulty of negotiating satisfactory terms with the Turkish Government. The "Chester Concessions," too, referred to on p. 154, were not a serious business proposition, and are unworthy of mention. On p. 133, in describing the desert air route from Cairo to Baghdad, the extraordinary statement is made that pilots cannot fly much above 100 feet without losing sight of the furrow track. This is a very great exaggeration, as the machines normally fly at several thousand feet, and the track can be distinguished with ease.

The ground covered by this manual is so extensive that a certain number of important factors have, naturally enough, been omitted. Thus the chapter on the Middle East rather overlooks the importance of the rôle assumed by the Royal Air Force in undertaking responsibility for the defence of Iraq and Palestine. The potentialities and achievements of troop-carrying aeroplanes in these mandated territories have not been sufficiently brought out. On p. 139 mention might have been made of the Lake Tsana irrigation project as affecting our relations with Abyssinia. Page 44 omits to state that Canada produces 120,000 tons of lead annually. The bibliography appended to several of the chapters is a useful feature, though by no means exhaustive. One notices in particular on p. 30 the omission of Lord Curzon's masterly Romanes Lecture on "Frontiers."

Misprints on the whole are remarkably few: "Firth" for "Forth" on p. 54, "Abu Sulir" for "Abu Suser" on p. 236, and "Berber" for "Berbera" on pp. 239 and 246, are all that jump to the eye. It seems a pity that spelling such as "Hedjaz" and "Djauf" should have crept in instead of the orthodox R.G.S. system.

The twenty-eight sketch-maps which supplement the text are on the whole clear, though not always accurate. For instance, the mileages between various Mediterranean ports as shown on Map 5 do not agree entirely with those given in the text, while the boundary between Italy's North African possessions and Egypt is out of date, and does not indicate the cession to Italy of the Jaghbub oasis. The same map shows Morocco as being merely a French "zone of influence," whereas in reality it is a protectorate.

Map 6, showing British possessions and steamship routes in the Western Atlantic, omits Bermuda altogether. Map 10 omits the important Venezuelan oilfield, while the chart showing British Cables (p. 166) shows the "all-red" cable to Fanning Island from Vancouver as running from San Francisco! These slight blemishes however can easily be rectified in a later edition, and hardly detract from the value of this most serviceable compendium of Imperial information. J. H. M.'C.

THE MONTHLY RECORD

EUROPE

Geodetic Connection between France and Corsica.

WHILE the geodetic junction between Spain and Algeria was accomplished by the great operation of 1879 carried out by Ibañez and Perrier, that between continental France and Corsica became an accomplished fact only last year, having been effected through the private initiative of M. Paul Helbronner, whose twenty years' labours in the triangulation of the French Alps had been brought to a successful conclusion in 1924. A brief outline of the operations was communicated by M. Helbronner to the Academy of Sciences in November 1925, and is reprinted in the January number of *La Montagne*, preceded by an introductory article by M. Lallemand. Such a junction with Corsica has long been a desideratum. In 1827 Durand had already carried rays from the Continent to Monte Carlo and another of the chief summits of the island, and a further but unsuccessful attempt had been made in 1863 by Proust, Bugnot, and Perrier, while in 1923 a reconnaissance had been made by the Service Géographique de l'Armée, without, however, offering much hope of success.

Supported by the Ministries of War and Marine, M. Helbronner proceeded to his task early last summer, and while June and July were devoted to a complete triangulation through Corsica from north to south, the necessary installations were made on the summits from which the junction was to be effected. These were the Stello in the Cape Corso peninsula, from which the stations above Nice would be visible, and the Cinto and Rotondo, from which the stations above Toulon could be sighted. The actual observations were begun at the end of July, fourteen days being spent on Monte Rotondo, thirteen on Monte Cinto, and nine on Monte Stello, with excellent results. On one of the clear nights an uninterrupted view of the projectors on five different summits was obtained (at distances varying from 70 to 256 kil.) from Monte Cinto, and from Monte Rotondo the Coudon near Toulon was observed at a distance of 271 kil., the longest geodetic ray hitherto secured. A connection was also effected with the Italian triangulation in Sardinia in the south and in Tuscany in the east, and the French Continental stations were occupied between September 20 and November 4. M. Lallemand points out that the precision attained is practically equal to that in the junction of Spain with Algeria.

Studies in Silesian Geography.

On the occasion of the twenty-first "Deutscher Geographentag," held at Breslau in June last year, the Geographical University of the Institute published a collection of studies, 'Beiträge zur Schlesischen Landeskunde,' edited by Prof. M. Friederichsen. These papers together cover much of the geography of Prussian Silesia in detail and should receive some notice here. From several points of view, the region is one of transition. In its morphology, this is well brought out by H. Knothe in his paper on the Lower Silesian–Lausitz "Heide." This area of approximately 8000 km.^{2} between the upper Elbe and Oder covers the southern limits of the last Ice Age at the point where they impinged upon the mountains of Northern Bohemia. This is reflected in its relief, soil, and vegetation: characterized by ancient moraines, sand-dunes, heaths, and pine forests. The study is particularly devoted to determining the glacial morphology and hydrography, but their further influence on the human geography is briefly indicated, in the contrast between the almost deserted pine forest area, and the industrialized districts around the brown coal deposits. Ethnographically, Silesia is also a transitional area between Teuton and Slav, which has produced a whole crop of problems in boundary making. The object of the paper by Charlotte Thilo, "Die Bevölkerungs-, Siedlungs- und Wirtschaftsverhältnisse im Hultschiner Ländchen," is to show that here a people of mixed race but with the German element predominating, should not have been cut off from Silesia and included in Czecho-Slovakia.

Silesia, again, has always been on a route of European importance, the Elbe and the Oder giving easy access from Central and Southern Europe to Western Germany. This is reflected in the history of the towns, as is emphasized by F. Enderwitz in "Das Werden und Wachstum Breslaus," and by P. Steinert in "Oppeln, Oberschlesiens Regierungshauptstadt." The Oder in the neighbourhood of Breslau meanders in a wide flood plain, here almost 7 km. wide, with its course broken by sandbanks and islands. To the south, in the "Loess" district about 3 km. from the river, Stone Age settlements have been traced. Later, in the Bronze Age, probably through the recognition of the value of the river pastures, settlements were established along the river and on the islands. On the left bank, at a point where islands offered an easy crossing, Breslau, "the bridge town of the Oder," grew

up. The date of its foundation is uncertain, but in the year 1000 it was an episcopal see. At first largely Slav, its trade relations drew it into closer connection with Germany, until Silesia was finally annexed to Prussia by Frederick the Great. The town was destroyed by Mongol invaders in 1241, but since its re-building it has grown steadily. At this point converged the southern routes from Glatz and Ratisbon, the latter coming *vid* Oppeln, and the eastern route from Kiev and Crakow, to continue down the river to Western Germany. The coming of the railways and the industrialization of Silesia have increased the importance of Breslau, so that its present population is approximately half a million, and the paper contains proposals for regulating its further growth. Oppeln is an administrative centre, augmented by the development of the cement industry. The remaining papers are by G. Bleicher on "Die Bartschniederung," a regional study of the swampy sparsely populated valley of the Bartsch in N.E. Silesia, and by R. Winde on "Das Bober-Katzbach-Gebirge," a study of another little-known district, "where time appears to have stood still." All the papers are illustrated by sketch-maps and diagrams and are provided with bibliographies.

ASIA

Discovery of Aornos.

The President has received from Sir Aurel Stein a short preliminary account of an expedition into the territories of the Badshah of Swat, upon which he has been engaged for the past three months. He is working with the support of the administration of the North-West Frontier Province, and of the Badshah, and is accompanied by Surveyor Torabaz Khan of the Survey of India. The valley of the upper Swat is a large and fertile district, known to the ancient Chinese pilgrims, who visited its sacred Buddhist sites, as Udyana, that is, the Garden. Several parts had not been previously visited by a European, so that they were able to carry out valuable topographical survey work. The other object of the expedition was archæological: besides possessing many Buddhist sites, the valley was the scene of a campaign of Alexander the Great, prior to his invasion of the Punjab. Sir Aurel hoped to be able to identify on the ground the scenes of the Macedonian exploits as recorded by the Greek authors.

After moving along the Swat and examining many ancient hilltop refuges in the side valleys, he reached the mountainous tract of Swat Kohistan, known locally as Torwal. This had only recently been brought into political dependence upon Swat, and had not been visited by a European. It is an Alpine region with peaks rising to 19,000 feet, glaciers, confined gorges, and heavy forests. Here the former Dardic-speaking inhabitants of Swat took refuge before the Pathan invaders, and preserved their Torwali dialect and folklore. Sir Aurel obtained specimens of these for the Linguistic Survey, as well as some anthropometrical records. In the upper Swat valley, immediately below Torwal, he examined two sites mentioned by the Chinese as being particularly hallowed by traces of the Buddha. One showed signs of continued local worship. Sir Aurel now left the valley and crossing snow-covered passes entered the mountains of Ghorband, Kana, and Chakesar, which lie between the Indus and the Swat watershed. His object here was to locate "Aornos," a natural stronghold which Alexander had taken by assault. This fortress was supposed to be on Mount Mahaban, north-east of Peshawur district, until a visit by Sir Aurel in 1904 showed this to be an impossibility. His attention was directed to the Ghorband region by the late Col. R. A. Wauhope.

R.E. Beyond the Swat-Indus watershed, a high detached spur runs eastwards between the Ghorband and Chakesar valleys. On this spur, at a height of 7,600 feet overlooking a bend of the Indus, there is a wide, level alp, known locally as Pir-sar, " holy man's height." This site was examined by Sir Aurel, who believes that this plateau was the rock stronghold of " Aornos " captured by Alexander. Above it rises a rugged peak called Una, which he suggests represents the name set down as " Aornos " by the Greek writers. Sir Aurel was travelling towards Buner to complete his work.

Dutch Scientific Expedition in East Central Borneo.

Reference was made last year in the *Journal* (**66**, p. 567) to this important expedition, organized by the " Comité voor Wetenschappelijke Onderzoekingen " for the exploration of the least-known parts of the island about the headwaters of the Mahakam, Kajan, and Kelai rivers. The information then received brought down the narrative to the end of June 1925, when the advance party under the leader Capt. Buys had reached the upper course of the Telen, the chief northern tributary of the Mahakam. The second and third (final) reports since received tell of the leader's exploration of the sources of the Telen and adventurous journey across the compound water-parting between the three rivers named to the posts on the Upper Kajan, and return by a different route. The Dyaks under their old headman Beng Wung continued to cooperate loyally in the arduous work of navigating the upper Telen, whose course was in great part strewn with rocks or broken by rapids, and shut in by rocky walls, though some calm stretches intervened. The most serious obstacle is caused by the rapids of Leah Leng, above which the river, though shallow and very winding, was again navigable until it split up into various head-streams, at the junction of one of which a base camp was established. These streams descend from a mountain-knot of which the highest summit bears the name Kong Kemul, a secondary one to the west being known as Ding Mul. The former (height 1847 metres) was climbed in unpleasant conditions owing to the cold and heavy rain, and it was feared that the constant fog would prevent any distant view, but a short clear interval made it possible to gain an idea of the lie of the land. It proved that existing maps were very incorrect. Whereas they have shown the basins of the Mahakam and Kajan as separated by the upper course of the Kelai, the three basins really meet at the Kong Kemul, from which the three dividing ranges radiate.

Returning from this trip to the base camp (September 8) Capt. Buys found that the rear-guard had just arrived, and news from the outer world was thus obtained after a long interval. Leaving his scientific coadjutors at the base camp to carry out researches in the surrounding country, Capt. Buys started again on September 14 on his expedition to the Kajan, accompanied by Lieut. Soeratman, the native surveyor Tjitro, a sergeant with eight soldiers and fifteen convicts, and twenty-nine Dyaks headed by Beng Wung. The journey was an arduous one owing to the broken and forest-clad nature of the country, and many of the party fell ill with beri beri, but it was carried out successfully with the loss of one Dyak only. Kong Kemul was reached by a more easterly route than before, and a descent made thence to the headwaters of the Kelai, the watershed between this river and the Kajan being afterwards crossed, and a descent made to the Kajan Ok. This was crossed by the help of a leaky canoe and followed down to the main Kajan, from a post on which the food supplies were after some delay replenished. For the return a more westerly route was chosen, and it proved more difficult than the outward way, the only tracks in

parts being those made by wild animals. The whole region appears to be uninhabited except by wandering Dyaks who visit it for the collection of gutta percha. Preliminary reports by the geologist, botanist. and zoologist accompany that of Capt. Buys. On the Upper Telen the principal formation seems to be ancient slates, metamorphic and eruptive rocks, the Liah Leng rapids being caused by a hard band of quartz-porphyry.

The Island of Urta-tugai.

We are indebted to Mr. W. R. Rickmers for the following note:

"I am sending you a few photographs, taken in 1913, of the island of Urta-tugai. This must be the island mentioned in recent press reports about a Soviet–Afghan frontier dispute.

"South of the Bukharan city of Kuliab and north of the Afghan town of Talikhan (sheets VIII/5 and IX/5 of the Russian 10-verst-map) the Oxus forms two branches encircling the island of Urta-tugai. It has a surface of 120 square miles which is covered with reed swamps, jungle, and park-like spaces. This wilderness swarms with pheasant, pig, deer, and tiger. The small population is distributed over a few miserable settlements, the chief village being Darkat. When I visited the island in 1913 there were no troops on it. The officers and men of the frontier post at Parkhar occasionally crossed over for the sake of sport. In 1913 the island seemed to be neutral ground, for one was able to cross over to it without being stopped by frontier guards. At Kokul, where the arms of the river meet again, there was a public ferry.

"I fail to grasp the economic or strategic importance of the place. A garrison must be uncomfortably conscious of the fact that retreat may be impeded by the river."

The photographs accompanying the note have been placed in the Society's collection.

AFRICA

Scientific Expedition in Italian Somaliland.

An expedition for geographical, geological, and other research in Italian Somaliland was carried out successfully in the first half of 1924 by Signors G. Stefanini and N. Puccioni, under the auspices of the Italian Geographical Society and with the support of the Colonial Ministry and other Government departments both in Rome and in the colony. A comprehensive account of the operations and results of the expedition is given in the *Bollettino* of the above Society, N. 1–2, 1926. The first and largest part of the work was done in the southern part of the colony, between the lower courses of the Webi Shebeli and Jub rivers, where Sig. Stefanini had previously carried out geological researches in 1913. It included a route survey with determinations of altitude by aneroid, and a study of the geology, hydrology and meteorology, botany, zoology and anthropology of the districts traversed. Incidentally the narrative sheds an interesting light on recent developments in the colony, especially the agricultural experiments along the lower course of the Webi Shebeli, which are being carried out with energy and success. Roads capable of carrying wheeled traffic, at least in the dry season, have been made in various directions, and a good part of the main intinerary was done by motor-car, though some of the subsidiary trips were made with the help of mule or camel transport. It was found that while sand-dunes occur on the left bank of the Shebeli to 130 kil. from the coast, the river has barred their advance to the other bank, though in turn they have cut the river from the sea and diverted it towards the Jub. Between the two

rivers, which flow through low-lying plains, the country consists partly of a limestone plateau (mainly Cretaceous, though Jurassic limestones are also mentioned), partly of a more strongly eroded tract of granite forming a mass of isolated bosses. Near the Jub there are groups of tabular hills of gypsum and sand, all with a capping of basalt, which is more widely diffused than has been supposed. The narrative includes many details on the vegetation, fauna, etc., and observations were made of the blind fish fauna of certain wells which appear to be connected with large underground cavities. Some of the so-called "tombs of the Madinle" (piles of big stones, said to date from pre-Somali times) were opened, but neither bones nor artefacts were discovered.

The second district visited was that of Obbia, the hinterland of which has till now remained virtually unknown. A point in the interior about 130 kil. from the coast in a direct line was reached, and the return made by a different route. The country is generally barren and inhospitable, though bush-covered in parts and frequented by the pastoral Haber Ghedir, who raise a few miserable crops. Lines of dunes, fixed or mobile, shut off the interior from the low coastal tract, and prevent any drainage to the sea. Much of the interior is a desolate plain of gypsum with salt incrustations, but there are some shallow valleys bordered by lines of rocks. The third part of the programme was concerned with the almost equally unknown extremity of the "horn" of Africa—the Mijurtin country. Landing a little north of Ras Hafun, the travellers went south parallel to the coast to Illig, at the mouth of the Nogal, the valley of which was then ascended to a point within British Somaliland, from which the party struck north and reached the north coast at Bosaso, thus gaining a good general idea of the nature of the country. The southern part is a wide limestone plateau reaching a height of over 1000 metres, sloping gently to the south-east. It is furrowed by the valleys of the Darror and Nogal, parts of which are quite dry, even the bed of the streams being lost to sight. North of the Darror the surface is more mountainous. The limestones of the plateau (and likewise those of the Hafun peninsula) were found to be of Tertiary age, whereas none later than the Cretaceous had been thought to exist here. The region forms a natural link between British Somaliland, Socotra, and Southern Arabia. A report on the anthropological work, which included a considerable number of measurements of natives, is given by Sig. Puccioni.

AMERICA

Mackenzie's Rock in British Columbia.

It is well known that Alexander Mackenzie, on completing the first traverse of the North American Continent at its full width, recorded the fact of his arrival at the shores of the Pacific by inscribing the following sentence on a rock near an Indian village: "Alexander Mackenzie, From Canada, by Land, the Twenty Second of July, One Thousand Seven Hundred and Ninety-Three." After being lost for years, the site of this rock has lately been identified with practical certainty by Capt. R. P. Bishop, a trained surveyor engaged in professional work near Bella Coola, the spot where Mackenzie first touched salt water at the head of the North Bentinck arm of Burke Channel. The chief difficulty in recovering the site has lain in the discrepancy between the text of Mackenzie's narrative and the footnotes written some years later when the traveller endeavoured to plot his route upon Vancouver's chart made in the interval. It is not surprising that errors should have occurred after that lapse of time, and by discarding the statements in the notes and guiding himself rather by the courses and distances from Bella Coola given in the journal Capt. Bishop has been

able to lay down the explorer's track to a point on the north side of Dean Channel, just above Elcho harbour, where a rock and traces of a ruined Indian village exactly fill the requirements. Certain discrepancies, it is true, still exist, but they can be got over by supposing, (1) that in transcribing his notes Mackenzie inadvertently wrote one-quarter for 4 miles; (2) that he made the natural mistake of taking a projecting point for an island; and (3) that at one part of the route, when having trouble with the Indians, he omitted to enter the course in his note-book. Capt. Bishop's detailed discussion has been printed as No. 6 of the "Historic Site Series" issued by the Department of the Interior at Ottawa, fully illustrated with photographs and a chart.

Mounts Mallory and Irvine, Sierra Nevada.

The Mount Everest Committee have received through the courtesy of Mr. Edward Arnold the following extract from a letter of Mr. Edward Rainey, Executive Secretary to the Mayor of San Francisco:

"Last summer Mr. Norman Clyde, of Independence, Inyo County, California, climbed two peaks in the vicinity of Mount Whitney (14,501 feet) the highest mountain in the United States. No record exists of a previous climb of these peaks. He suggested to the Sierra Club that the Club sponsor the naming of these peaks after Mallory and Irvine. The Club so recommended to the United States Geographic Board, and the Board has given its approval. Mallory (13,870) is on the main crest of the Sierra Nevada about 5 miles south-east of Mount Whitney. Irvine (13,790) is about a mile east of Mallory. These peaks are in a wild and very beautiful region, and the altitudes equal or exceed those of our most interesting peaks."

Heavy Rains on the Desert Coast of South America.

During the months of January, February, and March 1925 torrential rains are reported to have occurred on the nearly rainless coasts of Chile, Peru, and Ecuador, causing vast inundations and complete transformation of the desert surface. The fact has been recorded in the *Meteorological Magazine* and elsewhere, but a full and graphic description by R. C. Murphy under the title "Oceanic and Climatic Phenomena along the west coast of South America during 1925" appears in the *Geographical Review* of New York for January 1926. The rains were associated with a more southerly extension than normal of the warm Humboldt counter-current known as *El Niño*, producing such extraordinary sea temperatures as 80° F. in the harbour of Callao, 79° near Mollendo, and 70° even as far south as Antofagasta and Valparaiso, this heat being, at least in part, the cause of great destruction of marine life. The arrival of the warm water, which was accompanied by a northerly wind, appears to have been fairly contemporaneous with the onset of the rains, which were intense and continued over many weeks. At Trujillo, where the mean yearly fall is practically nil, some 16 inches fell in March 1925; and at Arequipa, where the annual fall is about 4 inches, 5 inches fell in the last ten days of January alone. The letters which are quoted of persons living in these parts are of marked interest: thus, "the desert became a garden. . . . Almost every evening we were pestered by swarms of insects, of ever-changing variety and of every size and shape imaginable. . . . There was rarely any wind; the sea had a lifeless uncanny look, and we never saw the sun."

Whilst the temporary reversal of the normal desert-producing *régime* of ocean and wind currents along this coast, and the arrival of vast quantities of humid equatorial air, are undoubtedly the underlying factors in the situation, these

could hardly be the immediate exciting cause of the rains. We have carefully examined the article under notice for any additional information respecting the accompanying meteorological conditions, and we think that statements to the effect that the main northerly current which prevailed during the wet period was associated with temporary reversals to southerly wind provide the clue to the problem. It is highly probable, therefore, that those heavy rains were due in the ordinary way to convergence of air currents, and that they occurred along a "front" or line of discontinuity between the warm humid equatorial air associated with *El Niño*, and the ordinary cool dry south-east wind associated with the Humboldt current of this coast.

An advance of the counter-current *El Niño*, with increase of rain, was also noted to some extent in 1918, but the last occasion at all comparable to 1925 occurred in 1891, though the change does not appear to have then been so severe. It seems, however, pretty clear that what happened along the Peruvian coast in the early months of 1925 was not a true meteorological abnormality, if there is such a thing, that is to say, an event the like of which has never happened before, but quite a "normal abnormality" in that it is repeated with much the same intensity at intervals. It is, indeed, suggested that the fortunes of Pizarro were favoured by his chancing to land upon the desert shores during one of these rare *años de abundancia*.

GENERAL

More New Light on the Verrazzano Brothers.

In the *Journal* for April 1910 (vol. 35, p. 428) we referred to the discovery by Sig. A. Bacchiani of an important MS. version of Giovanni Verrazzano's letter to the French King Francis I., describing the voyage of 1524, during which almost the whole of the eastern coast-line of the United States was explored for the first time. It has now fallen to the lot of Sig. Bacchiani to bring to light another and scarcely less interesting document, through which new light is shed on the last unfortunate voyage of the Florentine navigator in 1528. This is a rhymed history of or commentary on contemporary events and personages, preserved in MS. in the Museo Civico at Como, and written by Giulio Giovio, nephew and coadjutor of the famous Paolo Giovio, Bishop of Nocera. As poetry it is quite devoid of merit, but none the less (or perhaps for this very reason) it may be regarded as trustworthy in point of fact. The writer imagines himself to be conducted to the lower world by a venerable old man and to hold conversations there with many of the great men lately dead—sovereigns, soldiers, navigators, literary men, and artists—some of whom had been known to him personally when alive. After hearing from Cortes an account of the latter's adventures and conquests, and congratulating him on the great results which followed therefrom, the author contrasts this fate with the less fortunate one of Verrazzano, and seizes the opportunity to give some details about the voyages of the Florentine, and especially that of 1528 in which he met his tragic death at the hands of cannibals. For this second voyage (as also for the doings of the navigator in the interval between the two) our information has been excessively scanty, so that any further light on the subject is welcome. The life-history of Verrazzano has been the subject of wild and unfounded speculation, and he has been regarded by some as a mere adventurer, while others have thrown doubt on the very fact of his voyages, though his credit has in recent times been abundantly re-established. Sig. Bacchiani recapitulates all the evidence we have for the course of events between the two voyages (showing the entire lack of foundation for the theory that the navigator offered his services to the King of

England) and for the organization of the second, in which, as also on the voyage itself, he had the assistance of his younger brother Gerolamo. Now, as Giulio Giovio expressly states that he received his information by word of mouth from this same brother (and the intimate relations existing between the two families are known from other sources), there is every reason to trust the account now brought to light. The main object of the second voyage (which like the first had undoubtedly an official character) seems to have been the search for a passage to the Pacific south of the regions explored on the first. For this purpose a course was shaped for Florida, and the voyage continued by the Bahamas to the lesser Antilles *en route* for Darien. The well-known planisphere of Gerolamo Verrazzano (1529) marks the "Isole dei Canibale" in a position corresponding to that of the lesser Antilles, on one of which the commander landed, whereupon he and his companions were attacked and killed, and their bodies eaten, in sight of those who had remained on board, including the horrified brother who told the story. Sig. Bacchiani discusses the cartographical results of the voyages, all due directly or indirectly to the labours of Gerolamo, who, he thinks, deserves a more conspicuous place than has yet been accorded him in the history of the great discoveries.

CORRESPONDENCE

Water Requirements of Desert Camels

CAPT. MURRAY'S letter in the May issue of the *Journal*, on the watering of grazing camels and the existing conditions in the south-eastern desert of Egypt, is of considerable interest, and I should like to endorse his statement that when green grazing is available, camels, when doing only a moderate amount of work, can go for weeks, or even months, without drinking. This I imagine applies to most ruminants.

The water requirements of desert-bred camels subsisting on dead herbage plus a grain ration is, however, strictly governed by conditions of temperature and amount of work being performed. Curiously enough, it was in the same district from which Capt. Murray writes that I once experienced great difficulty in regard to water. This was in the winter of 1920–21, when almost the whole of the Eastern desert was in the grip of a severe drought and green herbage was nowhere to be obtained. In the south of this region all the nomads were collected round the foot of the Elba mountains, that favoured spot where water and grazing never seem to fail. After being watered at Elba on 26 December 1920, my camels, with full loads and averaging 20 miles daily, trekked northwards and, owing to their refusal to drink of the coast wells—which in that year of drought were more than usually saline—had to carry on without water for eight clear days before reaching Bir Shenshef, south-west of Berenice, on the ninth day, 4 January 1921. On this occasion the animals had about reached the limit of their endurance, though they might have been able to go on a day or two longer had they not been on continuous trek for several weeks and out of condition owing to the want of grazing. One's sense of responsibility is always closely touched when these patient beasts fall by the way, but on this expedition neither the Sheikh nor I had been able to foresee the immediate causes of the several casualties our transport sustained—the complete absence of green grazing and the refusal of the animals to water at the coast wells, such as Adal Deib and Bir el Hasa.

Within my experience a hard-worked desert camel requires watering in moderately temperate weather not less often than every four to five days, and consumes, in preliminaries, main drink, and afterthoughts, between 9 and 12 gallons. Unless suffering acutely from thirst camels are slow and deliberate drinkers.

H. J. L. BEADNELL.

First European Visitor to Leh

With reference to the review of De Filippi's book, 'Storia della Spedizione Scientifica Italiana nel Himalaia Caracorum e Turchestan Cinese (1913–1914),' which appeared in the *Journal* for September 1925, the reviewer, in stating (p. 255) that Desideri gave us the first account of Leh, would appear to have overlooked the account of the visit of Francesco de Azevedo, who left the first description of Leh that I have been able to trace. Azevedo entered Leh on 25 October 1631, nearly a century before Desideri, and describes Leh as follows: "It is built on the slope of a small mountain and numbers about 800 families. Half a mile lower down, but still quite visible, flows the river that goes to Lahore. By the town itself passes a mountain stream, which works a large number of mills; a few trees are found here."

This information has been taken from Father C. J. Wessels' book 'Early Jesuit Travellers in Central Asia,' a most exhaustive treatise on this subject and the first attempt to collate existing accounts of these early travellers.

B. K. FEATHERSTONE.

MEETINGS: ROYAL GEOGRAPHICAL SOCIETY: SESSION 1925–1926

Twelfth Evening Meeting, 26 April 1926.—Lord Edward Gleichen, Vice-President, in the Chair.

ELECTIONS.—Commr. Harry Thring Bennett, D.S.O., R.A.N.; Captain Victor Wilson Bratton, I.A.R.O.; Alfred Drake Brockman; Walter Lerwill Cocks, B.SC.; Sydney Herbert Cook; Henry Cornwell; Professor Emerson D. Fite, A.B.; Lieut. D. Forbes, R.N. (retired); Archibald Freeman; George McMurtrie Godley; John Almeric de Courcy Hamilton; Lieut. Richard St. John Hartley; Captain John V. Holland, V.C., I.A.; Dr. Willard Rouse Jillson, B.S., M.S., SC.D.; Samuel McKay; Edward William Nesham; Major E. W. Polson Newman, B.A.; Lt.-Col. Sir Philip Wigham Richardson, O.B.E., V.D.; Lt.-Commr. George Hamilton Stirling Sulivan, R.N. (retired); Captain Thomas Freeman Vernon, I.A.; John Huth Walters, M.S.E.; E. R. Ward, P.A.S.I.

PAPER: A recent journey to Gudru and Gojjam (Abyssinia). Mr. C. F. Rey.

Thirteenth Evening Meeting, 10 May 1926.—Owing to the General Strike this meeting was abandoned.

Seventh Afternoon Meeting, 17 May 1926.—The President in the Chair.

PAPER: The Nyazaland Section of the Great Rift Valley. Dr. F. Dixey.

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PRINTED BY WILLIAM CLOWES AND SONS, LIMITED, LONDON AND BECCLES, ENGLAND.